PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

MATHEMATICS 51

512.831

4383. Pauli's identities in the Dirac algebra. MADHAVA RAO, B. S. *Proc. Indian Acad. Sci.*, **22**, 408–22 (*Dec.*, 1945).—It is shown that by choosing suitable forms for 4×4 matrices as products of Dirac matrices and matrices of rank 1, the generalized identities of Pauli which hold in the Dirac algebra may be derived. Various further identities, not given by Pauli, are also derived; all types of identities can be deduced by considering 5 primitive types of matrices. L. S. G.

512.831

4384. Determinants and matrices with applications in physics and technology. [Vorträge über Determinanten und Matrizen mit Anwendungen in Physik und Technik.] SCHMEIDLER, W. *Berlin, Akademie-Verlag G.m.b.H.* (1949) *pp.* viii + 155. *In German.*—This is a carefully presented account of the properties of matrices and determinants, and of the methods for manipulating matrix expressions where they arise in physical problems. Some interesting results are given for the solution of a system of linear equations by iteration, and other methods of approximation. Limits for the errors are obtained. Practical methods for evaluating numerically the latent roots and vectors of Hermitian matrices are given. The use of matrix methods in solving systems of linear differential equations is explained, and some physical applications are considered. These include oscillations in an electrical network of small resistance, and oscillations of a pendulum whose point of suspension oscillates. L. S. G.

513

4385. Pursuing curves. HOSEMANN, R. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, I,*" 269–307 (1948) *In German.*—Theoretical and practical details involved in the construction of pursuing curves are reviewed. The curves are important in torpedo design. L. S. G.

513.76/.77

4386. Practice of conformal mapping. ULLRICH, E. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, I,*" 93–118 (1948) *In German.*—General work done during the period is reviewed and then practical problems in aerofoil theory and aeronautics, which make use of conformal mapping, are discussed. Various approximate methods for effecting conformal transformations are described. These include physical methods (e.g. electrolytic tank), mechanical methods, and methods involving the numerical solution of integral equations. Technical applications of conformal mapping are outlined. L. S. G.

517.942

4387. Subharmonics in a non-linear system with unsymmetrical restoring force. REUTER, G. E. H. *Quart. J. Mech. App. Math.* **2**, 198–207 (*June*, 1949).—The behaviour of an oscillatory system which is positively damped but in which the restoring force is unsymmetrical about the equilibrium position is investigated. It is shown that if a periodic external force whose period is approx. ½ the natural period is applied, the system may oscillate with twice the period of the external force (such oscillations are called subharmonics of order 2). The subharmonics only occur when the amplitude of the external force reaches a certain critical value; if the forcing period is slightly $> \frac{1}{2}$ the natural period, there is a second critical amplitude beyond which the ordinary forced oscillation (with the same period as the external force) becomes unstable. In the range between the 2 critical amplitudes, therefore, the forced oscillation or the subharmonics may occur (which of them occurs will depend on the initial displacement and velocity of the system), whilst beyond the second critical amplitude only the subharmonics can occur. This gives rise to a "hysteresis" effect when the amplitude of the external force is increased and then decreased again. A.

518

4388. Graphical and numerical methods. COLLATZ, L. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, I,*" 1–92 (1948) *In German.*—The subjects reviewed are (1) numerical differentiation and integration; (2) interpolation; (3) solution of equations, including linear and non-linear systems; (4) numerical and graphical solution of ordinary and partial differential equations; (5) integral equations and functional equations. Some new results are reported, e.g. new iterative methods for solving algebraic equations and systems of equations, including a discussion of errors. An extensive bibliography (222 papers) is given. L. S. G.

518.2

4389. Mathematical tables. Numerical investigation of special functions. WALTHER, A. AND UNGER, H. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, I,*" 167–83 (1948) *In German.*—Tables of Bessel functions, $J_n(x)$, for $n = 0(1)30$ and $x = 0(0{\cdot}2)65$ were constructed; also for $n = -30{\cdot}5(1)31{\cdot}5$, and $x = 0(0{\cdot}2)20$. Numerical solutions of the Lamé equation were obtained. An exhaustive list of references to tables of special functions is given. L. S. G.

518.2

4390. Table for use in the addition of complex numbers. RYBNER, J. AND SØRENSEN, K. S. *Copenhagen, J. Gjellerups Forlag* (1948) *pp.* xiv + 95. *In English.*—In the equation $Re^{i\alpha} = 1 + re^{i\theta}$, the numerical values of R and α are tabulated as functions of r and θ for $0 \leqslant r \leqslant 1$, at intervals of 0·01, and for $0 \leqslant \phi \leqslant 180°$ at intervals of 1°. The method of construction of the tables is fully explained. L. S. G.

518.2

4391. Table of $\int_0^x I_0(x)dx$ for $x = 0(0{\cdot}1)20(1)25$. ROTHMAN, M. *Quart. J. Mech. App. Math.*, **2**, 212–18 (*June*, 1940).

518.5

4392. Principles and progress in the construction of high-speed digital computers. BOOTH, A. D. AND BRITTEN, K. V. *Quart. J. Mech. App. Math.*, **2**, 182–97 (*June*, 1949).—The basic principles underlying the mathematical design of high-speed digital computers are discussed and the necessary components of such machines defined. Scale of notation, the form of the "memory," the action of the control, and other practical details are considered, and a brief discussion is included of the exact arithmetic functions of which these machines must be capable. This is followed by a description of current computer projects in America. Aiken's second relay computer at Harvard, the Bell relay machine, E.D.V.A.C., and the Princeton electronic computer are described briefly and an idea given of their state of completion in 1947. A.

518.5

4393. The Zuse computer. *Math. Tables Aids Comput.*, **2**, 354–8 (*Oct.*, 1947).—This is a German digital computer. It uses telephone relays (electromechanical) for operating on numbers, but stores numbers in a "mechanical relay" which seems to be some sort of cross-bar switch. As built the machine works in binary notation to 5 decimal digits. It has a floating decimal point ($10^{\pm 20}$). Only a predetermined sequence of orders can be followed, entered on punched film. Numbers may be hand-set or entered on the tape, in decimal form. When complete the machine will be able to discriminate, and will store 1 024 numbers (in a space of less than one cubic yard). Complex number problems will not require special programming. Multiplication time is one second, transfer time being negligible in comparison. S. M.

518.5

4394. Film slide rule. STIBITZ, G. R. *Math. Tables Aids Comput.*, **2**, 325 (*Oct.*, 1947).—Functional scales printed on film are used to interpolate between the teeth of a film sprocket. Counting sprocket teeth or linking sprockets by gears avoids errors due to scale expansion. Accuracy about 10 times that of 20-in desk slide rule. S. M.

518.5

4395. Nomography and slide rules. WALTHER, A. AND KRON, A. W. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, I*," 119–27 (1948) *In German.*—A short review of German war-time publications. Several nomograms and slide rules developed for special purposes are mentioned, e.g. a cylindrical slide rule for multiplication of vectors or complex numbers. L. S. G.

518.5

4396. Mathematical machines and instruments. Instrumental methods. WALTHER, A. AND DREYER, H. J. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, I*," 129–65 (1948) *In German.*—Digital machines are firstly discussed, and numerous references are given to papers dealing with the use and limitations of such machines. The construction of tables of various functions is described. Machines which operate continuously are then considered. These include devices for differentiation and integration, harmonic analysis and synthesis, the differential analyser and machines for solving partial differential equations and problems in conformal transformations. L. S. G.

518.5 : 621.318.57

4397. Details of the simultaneous equation solver. GOLDBERG, E. A. *RCA Rev.*, **9**, 394–405 (*Sept.* 1948).—Design and practical details of instrument described in Abstr. 3072 (1948) for solution of 10 simultaneous eqs. with an accuracy of $\sim 0{\cdot}1\%$ (reducible by iterative methods). An electronically stabilized power supply with output impedance of $10^{-4}\ \Omega$ at 1 kc/s is described. A. O. S. (R

519.2

4398. On the theory of age-dependent stochastic branching processes. BELLMAN, R. AND HARRIS, T. E. *Proc. Nat. Acad. Sci., Wash.*, **34**, 601–4 (*Dec.* 15 1948).—A summary of general results about the asymptotic distribution of population-size in a system generated by fission according to certain random schemes. N. L. J.

519.24

4399. The use of generalised Dirichlet's integral in solving some distribution problems of statistics. KRISHNA IYER, P. V. *Proc. Indian Acad. Sci.*, **22** 75–83 (*Aug.*, 1945).—The integral is used to derive the distribution of (1) the means and standard deviations of samples from normal and multinormal populations, and (2) the means of samples from types I and III populations. L. S. G.

519.25 : 527 : 621.396.93

4400. Theory of error distribution. Application to radio navigational aids. DUNCAN, P. F. *Wireless Engr*, **26**, 49–52 (*Feb.*, 1949).—The usual methods of calculating probable errors are described and applied to position-finding by radio methods where the position of the observer depends on "position-lines" from two transmitters. Assuming the Gaussian normal error law it is shown that if a large number of observations are taken, $1/n$ of them lie outside an ellipse given by $Ax^2 + 2Hxy + By^2 = \log_e n$ where A, H and B are constants and x and y are position co-ordinates. The 50% ellipse ($n = 2$) gives a measure of fix accuracy, and is such that of a large number of observations 50% will lie within and 50% outside the ellipse. In this way curves of constant fix accuracy are obtained. Correlation with experiment is good. C. A. H. (R

519.27

4401. An application of matrix algebra to the theory of errors. MARCANTONI, A. *Acta. Pont. Acad. Sci.* **10** (*No.* 27) 301–20 (1946) *In Italian.*—A system of linear equations whose coeffs. depend upon observations, together with exact conditions, is solved by the method of least squares. Using matrix notation formulae are obtained for the variances and co-variances of the solutions, and functions of them, in terms of the residuals and the reciprocal of the matrix of the normal equations. S. M.

519.27

4402. The foundation of the calculus of observations and the method of least squares. TIENSTRA, J. M. *Bull. Géod.* (*No.* 10) 289–306 (*Oct.*, 1948) *In English.*—An attempt to provide a new basis, free from "metaphysical conceptions" and resting on "physical fact

and sharply formulated hypotheses about properties of series of observations." N. L. J.

519.28

4403. On the postulate of the arithmetic mean. BOLDRINI, M. *Comment. Pont. Acad. Sci.*, **10** (*No.* 1) 1–4 (1946) *In Italian.*—Discusses the circumstances under which the arithmetic mean of a set of observations can be taken as a valid representative of the set. S. M.

ASTRONOMY . ASTROPHYSICS . GEODESY 52

522.615

4404. The construction and use of a photomultiplier type of photoelectric photometer. KRON, G. E. *Harvard Coll. Obs. Circ.* (*No.* 451) 10–29 (*Nov.*, 1946).—A reprint of a previously published mimeographed bulletin of the American panel on orbits of eclipsing binaries. An elementary summary of the theory of photocells, particularly as applicable to faint astronomical objects, is followed by a detailed description of the instrument made at the Lick observatory, using a 1P21 9-stage photomultiplier working at 90 V per stage and giving a total amplification of $5 \cdot 5^9$. Hints are given on the construction of this type of instrument, on observing technique and adaptation to various astronomical requirements. D. L. E.

522.615 : 523.821.5

4405. A photoelectric photometer employing an electron counting technique. YATES, G. G. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 6) 476–90 (1948).—Equipment employing an electron multiplier photocell with a pulse amplifier and an electronic counter is fully described, with circuit diagrams and component schedules. With an unselected tube the photometer can be used on stars down to 12th mag. with a 15-in telescope. A. HU.

523.11 : 530.12

4406. Transformation of the fundamental quadratic form of the de Sitter universe. VAN BERGEN, F. *Bull. Acad. Belge Cl. Sci.* (*No.* 12) **34**, 975–7 (1948) *In French.*—The transformation of coordinates which represents the de Sitter space-time as a fourfold in a pseudo-Euclidean fivefold is written down and used to show that this space-time is a hyperbolic space of Cayley. G. C. McV.

523.11 : 530.12

Spherically symmetrical models in general relativity. *See Abstr.* 4455

523.5 : 551.510.535 : 621.396.9

4407. A phenomenological theory of radar echoes from meteors. MCKINLEY, D. W. R. AND MILLMAN, P. M. *Proc. Inst. Radio Engrs*, **37**, 364–75 (*April*, 1949).—Combined visual, photographic and radar observations are summarized and general conclusions drawn. The radar echoes are classified into basic types according to their appearance on a range-time display. These types include echoes indicating approach, or recession, or both. Other observed features are: durations up to several min, complex structure for brighter meteors, and delays in the appearance of echoes. A phenomenological theory is proposed, involving a number of postulates concerning an *M*-region in the upper atmosphere. Kinetic energy and u.v. mechanisms are suggested to account for the ionization produced. In the *M*-region are visualized striae, or patches, which form a fine structure such that within them the physical properties of the atmosphere emphasize the creation and maintenance of meteor ionization. A qualitative explanation of all the observed echo forms is advanced on this hypothesis, and results on other wavelengths are consistent with it. A.

523.531

4408. Diurnal variations of meteor trails. LITTLE, C. A. Letter in *Phys. Rev.*, **74**, 1875–6 (*Dec.* 15, 1948).—Radar observations (at the Department of Terrestrial Magnetism, Carnegie Institution of Washington) from April to June, 1948, indicate unexpectedly not a summer- but a winter-frequency-distribution, in comparison with Appleton and Naismith [Abstr. 2006 (1947)] and Hey and Stewart [Abstr. 3046 (1946)]. There was also evidence of a distinct diurnal variation of the average distance of the trails: about 75 miles at night, but 130 miles at 9 a.m. local time. A. B.

523.6 : 523.161

4409. On the origin of comets. LYTTLETON, R. A. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 6) 465–75 (1948).—The passage of the sun through a cloud of interstellar dust may result in the convergence of dust particles behind it on to the accretion axis, where collisions will destroy their transverse velocities. For suitable relative velocities of sun and cloud that part of the dust stream so formed on the axis which is within a few 100 a.u. is captured and flows towards the sun. Internal gravitation then causes lengthwise contraction into aggregations which are identified with comets. Subsequent attraction would be to the c.g. of the solar system and would thus in general result not in collision with the sun but in orbital motion in long ellipses. Angular momentum about the sun may also be conferred by stellar and planetary perturbations. The upper limit set by the sun's disruptive field to the length of a segment of the dust stream leads to cometary masses consistent with current estimates. A. HU.

523.71

4410. The sun's stellar magnitude. WOOLLEY, R. v. D. R. AND GASCOIGNE, S. C. B. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 6) 491–502 (1948).—Photographic spectrophotometry is used to measure monochromatic magnitude differences between the sun and Sirius, using diaphragms to equalize the intensities. The differences are $25 \cdot 85$ at 6 209 Å, $25 \cdot 59$ at 5 550 Å, $25 \cdot 34$ at 4 945 Å and $25 \cdot 15$ at 4 510 Å. The photo-visual magnitude for the sun is $-27 \cdot 07$ apparent and $+4 \cdot 52$ absolute; its gradient on the Greenwich system is $1 \cdot 11$. A. HU.

523.72

4411. Solar hydrogen convection and origins of the ultra-violet stimulus for cometary and terrestrial spectra and the lower ionosphere. JOHNSON, M. *Mon. Not. Roy. Astr. Soc.*, **107** (*Nos* 5–6) 452–61

(1947).—The theory that hyperexcitation in comets and the ionosphere may be due to the liberation of Lyman radiation at the top of a convection zone close to the sun's surface is examined by calculating the continuum between 600 and 900 Å in an electron capture spectrum. Conditions are specified for the escape of such radiation from the sun. The optical depth of electron capture determines the extent of redistribution of the radiation into a Planck spectrum. Since this will fluctuate during solar disturbances, large changes in the extreme u.v. radiation can occur, as required by observation, without much change of the total energy output. A. HU.

523.72

4412. On the origin of solar radio noise. HAEFF, A. V. *Phys. Rev.*, **75**, 1546–51 (*May* 15, 1949).—The observed anomalous r.f. radiations from the sun are associated with sunspot activity and are believed to be generated within intermingling streams of charged particles issuing from active areas of the sun. Such streams have the property of greatly amplifying initial space-charge fluctuations over a range of frequencies determined by the density and velocity distribution of particles in the stream. The theory of generation of radio energy resulting from space-charge interaction between streams of charged particles is reviewed and applied to the solution of the solar radio noise problem. From estimates of average density and velocity distribution of solar particles the frequency of the most intense radiation (30 to 60 Mc/s) and the absolute value of radiation intensity at the surface of the earth (7 to 2)$\times 10^{-22}$ (watt/cm^2/cycle/sec.) are computed and found to agree well with measurements. The most probable spectral distribution of the anomalous solar radiation is derived in the form $E/E_m = (\lambda/\lambda_m)^2 \exp\{2[1 - (\lambda/\lambda_m)]\}$, where E_m is the maximum intensity corresponding to the wavelength λ_m. A.

523.73 : 538

4413. Solar magnetism and the suggested fundamental magnetization by rotation. CHAPMAN, S. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 3) 236–51 (1948).—The magnetic field of the sun is calculated according to the "fundamental" hypothesis, revived and revised by Blackett, that a rotatory mass flux f produces a magnetic field as if it were a negative electric current of intensity $\beta G^{\frac{1}{2}} f/c$, where β is a factor of order unity, G the gravitational constant and c the speed of light. The calculation is based on the density distribution given by Blanch, Lowan, Marshak and Bethe for the point convective model of the sun, and takes into account a non-uniform distribution of the angular velocity ω approximating to that given by Schwarzschild. The corresponding moment of inertia and angular momentum of the sun are calculated. On this basis, and taking the sun's polar magnetic intensity to be 50 (or 10) gauss, β is estimated as 2 (or 0·4) as compared with 0·3 for the earth. The inferred intensity at the centre is a few thousand gauss, similar to that of sunspot magnetic fields. To a depth of about 100 000 km the field increases downwards approximately as if it were due to a point dipole at the centre. Lower down the increase is less rapid; for the radial component it continues to the centre. The horizontal component attains a maximum about halfway down, where its intensity in the equatorial plane is a few hundred gauss; thence it decreases downwards to zero at about $\frac{1}{3}a$ from the centre (a = solar radius), below which, with reverse direction, it increases steadily to the centre. The non-uniformity of rotation introduces non-dipole terms into the field potential, which are calculated on the assumption that ω varies linearly with the distance from the axis. Even if ω is doubled or halved at the surface at the equator, compared with its axial value, the non-dipole terms are too small to be observable at present. Finally it is shown that the magnetic fields of sunspots cannot reasonably be supposed to have this fundamental character. The necessity to attribute these intense fields to some different mechanism (as yet unknown) seems to weaken the case for the "fundamental" hypothesis. A.

523.7

4414. On turbulence in the sun. TUOMINEN, J. *Ann. Astrophys.*, **11**, 165–73 (*July–Sept*, 1948) *In English.*—Departure from solid-body rotation of the sun can be qualitatively explained by the stabilizing effect of the general rotation on convection, the convection occurring preferentially along the axis of rotation. The amount of heat used in maintaining the movements against viscosity is calculated to be 9% of the total luminosity. This is converted into kinetic energy of turbulence before being dissipated by friction. Setting the mass integral of the turbulent kinetic energy to $\frac{1}{10}$ of the observed luminosity yields the relation $q^3/l = 0{\cdot}38$ where l is the "mixing length" and q the mean turbulent velocity. Rander's work [Abstr. 2012 (1941)] on kinematic viscosity enables the meridional velocity to be used to derive $ql = 1{\cdot}0\times 10^{13}$. Values of q and l so obtained are compared with those derived from the motion of sunspots, on the assumption that the differential rotation can be regarded as a 2-dimensional circulating current, and the agreement is satisfactory. M. W. C.

523.75 : 551.510.53

Ionospheric effects of solar flares. *See Abstr.* 5160

523.75

4415. Interpretation of electron densities from corona brightness. ALLEN, C. W. *Mon. Not. Roy. Astr. Soc.*, **107** (*Nos* 5–6) 426–32 (1947).—The Fraunhofer lines in the outer corona cannot be due to electron scattering since the temp. is so high that they would be broadened into a continuum. There must therefore be a component of coronal light due to scattering or diffraction by particles other than electrons. This component is estimated, at various radial distances from the sun, from the depths of the coronal Fraunhofer lines, and the true electron densities are computed after allowing for it. The interpretation agrees well with the author's hypothesis [Abstr. 3023 (1947)] of diffraction by interplanetary particles and with polarization measurements. The radial variation of coronal temp. is calculated from the new electron densities. A. HU.

523.7

4416. A note on the structure and internal composition of the sun. LEDOUX, P. *Ann. Astrophys.*, **11**, 174–84 (*July–Sept.*, 1948) *In French.*—The study of the consequences of a difference in mean molecular weights μ_e and μ_i between convective

core and radiative envelope respectively is extended to the case of abundant He. It is found that if μ_i/μ_e is appreciably different from unity, a zone of transition of μ is formed by turbulent mixture. Agreement between liberated and radiated energy of the sun is obtained if the H and He abundances are respectively $X_e = 0{\cdot}56$, $Y_e = 0{\cdot}40$, and $X_i = 0{\cdot}26$, $Y_i = 0{\cdot}70$. The estimated time required for such a distribution to be formed from an originally homogeneous composition similar to that of the envelope is 5×10^9 years, in fair agreement with other estimates of the sun's age. M. W. O.

523.76

4417. An analysis of solar atmospheric structure. EVANS, D. S. *Mon. Not. Roy. Astr. Soc.*, **107** (*Nos* 5–6) 433–51 (1947).—It is shown that all analyses of limb darkening assume, implicitly or explicitly, some auxiliary physical hypothesis to compensate for the lack of observational data at the extreme limb. The hypothesis chosen postulates a H convection zone, in which the temp. radiation is constant, overlain by a surface layer in which it increases linearly with depth. This model gives agreement with observations of limb darkening and Fraunhofer line variation across the disc. The variations expected in line strength in the i.r., for a smooth and for a rough solar surface, are computed: strengthening towards the limb is expected to be more common here than in the visible region. A. HU.

523.774 : 530.12

4418. Interferometric measurements of solar wavelengths and an investigation of the Einstein gravitational displacement. ADAM, M. G. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 6) 446–64 (1948).—A 5-prism spectrograph crossed with a Fabry–Perot interferometer was used to measure, against atmospheric O lines and laboratory Ne lines, the wavelengths of 14 solar lines in the red for 13 points across the polar diameter of a large solar image. The wavelengths at the centre of the disc are 0·005 Å > the vacuum arc values; this excess changes little with position on the disc until the last 10% of the radius, when it rapidly increases to 0·013 Å. When the observed wavelengths are corrected for Lindholm effect [Abstr. 375 (1944)] the residual shifts cannot be accounted for by a mixture of Einstein shift and Doppler shift due to radial currents without assuming impossibly large velocities for these currents. Observations are suggested which may provide a solution to the problem. A. HU.

523.813

4419. On radial parallaxes. ZAGAR, F. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **45**, 633–8 (*June*, 1948) *In Italian.*—Assuming constancy of flux, the apparent stellar magnitude m is related to the distance r from the earth by the equation $m - 5 \log r =$ constant. M, the rate of change of m and R $(= dr/dt)$ the radial velocity of the star (in km/hour) is therefore related to the distance r (in parsecs) by the equation $r = 222{\cdot}2 \times 10^{-8} R/M$. A knowledge of M and R enables the value of r, and hence of the parallax, to be calculated. The parallax so computed is called "radial." The possibility of determining M with some accuracy is discussed—it may involve continuous observations of m over a large number of years or even a century. The method, if it should prove practicable, would supply an independent means of determining parallaxes. V. C. A. F.

523.838 : 521.038

4420. An attempt to detect the magnetic field of a white dwarf. THACKERAY, A. D. *Mon. Not. Roy. Astr. Soc.*, **107** (*Nos* 5–6) 463–7 (1947).—The suggestion by Blackett [Abstr. 1715 (1947)] that the angular momentum of a white dwarf is associated with a magnetic field of several million gauss is tested by taking a series of spectra of Wolf 1436 with and without polarizing apparatus. No systematic Paschen–Back splitting of H_γ could be detected within an experimental error of 8 Å (10^6 gauss). A magnetic field cannot therefore contribute appreciably to the observed line-width of ~ 50 Å. A. HU.

523.841.1

4421. Remarks on the nova phenomenon. SCHATZMAN, E. *Bull. Acad. Roy. Belge, Cl. Sci.*, **34**, 828–33 (*Nov.*, 1948) *In French.*—The propagation to the surface of 10^{42} ergs of energy suddenly liberated at the centre of the sun is discussed in general terms. Radiation transfer may be neglected, and the energy is treated as a perturbation propagated as a shock wave [see Abstr. 1767 (1947)] and is shown to arrive at the surface in a comparatively short time. R. A. N.

523.841.2

4422. The penumbral part of the reflection effect in eclipsing variables—a reconnaissance. RUSSELL, H. N. *Harvard Coll. Obs. Circular* (*No.* 452) 1–8 (*Dec.*, 1948).—The penumbral effect in an eclipsing binary is due to the considerable size of the illuminating star compared with its distance from the reflecting companion. In a preliminary discussion it is shown to have a negligible effect on the reflected light in ordinary circumstances. D. L. E.

523.851.2

4423. On the galactic rotation of the globular clusters. PEREK, L. *Ann. Astrophys.*, **11** (*No.* 3) 185–92 (*July–Sept.*, 1948) *In French.*—Radial velocities by Mayall [Abstr. 1406 (1947)] are used to calculate the velocity of the sun relative to the galactic centre, and the general law of galactic rotation of the globular clusters. On the assumption that the average velocity is parallel to the galactic plane and perp. to the radius vector, the velocity V is given by $V = -60r - 50r^{-\frac{1}{2}}$, which is seen to depend only upon r, the distance to the galactic centre projected on to the galactic plane; rotation is retrograde throughout. M. W. O.

523.852

4424. New reduction of Holetschek's catalogue of nebulae. GRAFF, K. *S.B. Öst. Akad. Wiss.* (*Math. Naturwiss. Kl.*) **IIa, 156** (*Nos* 3–4) 93–128 (1948) *In German:*—Holetschek's extensive visual magnitude estimates of nebulae and star clusters (*Annalen der Sternwarte Wien*, **20** (1907)] are shown to represent a uniform photometric system, compatible with instrumental measurements. Graff's re-reduction is based on 4 instrumental series (on a catalogue by Graff, the Harvard catalogues, and measurements by Rosenhagen and by Hopman). A. B.

523.852.32 : 521.11

4425. On the dynamics of stellar systems. LINDBLAD, B. *Mon. Not. Roy. Astr. Soc.*, **108** (*No.* 3)

214–35 (1948).—A detailed account is given of the author's theory of spiral structure [Abstr. 35, 2909 (1949)], and the observed structures of several nebulae are discussed in relation to this theory. R. A. N.

523.852.32 : 521.11

4426. On the structure of spiral nebulae. TEN BRUGGENCATE, P. *Nachr. Wiss., Göttingen* (*No.* 1) 1–7 (1948) *In German.*—Chandrasekhar's potential [Abstr. 60 (1941)] for a non-stationary field with a central mass and a mass distribution with circular symmetry is transformed to a static potential q_0/r by Schürer's transformation $\rho(\tau)/\Phi(\tau) = r(t)$, $\theta(\tau) = \phi(t)$, $d\tau/dt = \Phi^2$ [*Astr. Nachr.*, **273**, 230–42 (1943)], r, ϕ, t and ρ, θ, τ referring to the static and non-static cases. The arbitrary function $\Phi(\tau)$ is chosen so that stationary circular orbits are the transforms of logarithmic spirals in the non-stationary motion. Nebular spiral arms are identified with the locus of stars which pass through a fixed point (ρ_1, θ_1) and have the same form as Milne's spirals [Abstr. 3031 (1947), 13 (1948)]. The theory provides a good representation of the arms of *M*33. It is suggested that stars of Baade's population I describe logarithmic spirals in the non-stationary field of stars of population II. R. A. N.

523.855

4427. Models of nebulae with radial motions. LEMAÎTRE, G. AND VAN DER BORGHT, R. *Bull. Acad. Belge Cl. Sci.*, **34** (*No.* 12) 955–65 (1948) *In French.*—Models are proposed for spheroidal extra-galactic nebulae in which the motion of the constituent stars is purely radial. The models are constructed by means of classical hydrodynamics and Newtonian gravitational theory. In one model the number of particles entering and leaving a sphere of radius r is constant; in the other, the number of particles having energies lying between E and $E + dE$, at distance r, is $\propto dE$. The resulting equations are solved in series, for the asymptotic forms of the solutions, and by iterative methods, for numerical values. The march of the log. of the density from centre to outer boundary, for both models, is not dissimilar to that observed in spheroidal galaxies. G. C. McV.

523.877

4428. Giant stars producing energy by C–N reactions. HAYASHI, C. *Prog. Theor. Phys.*, **2**, 127–34 (*July–Oct.*, 1947).—Equations of equilibrium are integrated inwards, the radius of the isothermal core being chosen so that the total rate of energy production in the envelope equals the luminosity. In detailed calculations for Capella and ζ Auri, 80% of the energy is found to be liberated in a thin shell of mean radius $2{\cdot}8 \times 10^{-2}$ that of the sun. R. A. N.

523.877

4429. On the problem of fitting of a radiative stellar envelope to a convective core. BURMAN, U. R. *Proc. Nat. Inst. Sci. India*, **15** (*No.* 2) 25–30 (1949).—The method described in a previous paper [*ibid.*, **9**, 237 (1943)] for the fitting of a convective core to a radiative stellar envelope is extended so as to be applicable to cases where the average molecular weight $\mu \neq 1$. The problem of fit for a stellar model with a discontinuity of μ across the interface is also discussed. A.

523.87

4430. The internal constitution of the stars. HOYL F. AND LYTTLETON, R. A. *Occ. Not. Roy. Astr. Soc* **12**, 89–108 (*Sept.*, 1948).—A semi-popular historic survey of theories of stellar structure to date. A. H

523.8

4431. Systematic corrections and weights of 108 st catalogues. GYLLENBERG, W. *Lunds Univ. Årsskr* **44** (*No.* 2) 70 *pp.* (1948) *In English.*—A homogeneou selection of stars common to the individual catalogu and the G.C. is used to set up for each catalogue table for reduction to the G.C. system. The cat logues date from 1783 to 1948. M. W.

525.1

4432. The figure of the earth. BULLARD, E. *Mon. Not. Roy. Astr. Soc. Geophys. Suppl.*, **5**, 186–9 (*Jan.*, 1948).—A purely numerical method has bee devised for the treatment of Darwin and de Sitter theory of the figure of a rotating earth in hydrostat equilibrium. This has been applied to the densi distribution suggested by Bullen [Abstr. 1688 (1942)] De Sitter's numerical constants λ_1 and κ_1 a found to have the values $\lambda_1 = 0{\cdot}00016 \pm 0{\cdot}0001$ $\kappa_1 = 68 \times 10^{-8}$. The ellipticity, on the assump tion of hydrostatic equilibrium, is found to $\varepsilon^{-1} = 297{\cdot}338 \pm 0{\cdot}050$.

525

4433. Observed characteristics in the components the motion of the pole. NICOLINI, T. *Atti Acad. Na Lincei* (*Mem. Cl. Sci. Fis. Mat. Nat.*) **2** (*No.* 1) 3– (1948) *In Italian.*—The authors determine the fund mental components, annual and Chandlerian, of t motion of the pole, using a method based on t theory of beats in acoustics. Noteworthy d continuities in the motion appear around the t years 1924 and 1939, essentially corresponding to large decrease in the amplitude of the Chandleri term. Between these discontinuities there is a certa regularity in the period and phase. V. C. A.

525

4434. Perturbations and discontinuities in the moti of the pole. NICOLINI, T. *Atti Accad. Naz. Lin* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 392–6 (*Dec.*, 1948) *Italian.*—Marked perturbations of the motion of t pole (especially in the Chandlerian terms) occur during the epochs 1922–23 and 1939–40. The auth draws attention to many concomitant geophysic disturbances (seismic or geomagnetic) during the epochs, possibly connected with the perturbations the motion of the pole. He believes that the irregularities in the motion of the pole may be due an expansion or contraction of the earth's cr varying from 15 cm to 3 or 4 m, neither uniform n regular, which may, moreover, be connected w Wegener's theory of the motion of continents. V. C. A.

525

4435. A resonance effect in the movement of t instantaneous pole on the earth's surface. MELCHI P. *Bull. Acad. Belge. Cl. Sci.*, **34** (*No.* 12) 969– (1948) *In French.*—Whilst resonance can account the amplitude variation of the long axis of t "annual" ellipse, it is less easy to explain that of short axis. W. A.

526

4436. The state of geodesy in Germany. KNEISSL, M. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, IV*," *pp.* 13–116 (1948) *In German.*—Covers the whole field of geodetic surveying and map making, including army methods, new instruments, methods of adjustment and corrections, mechanical calculation, precise levelling and map production. W. A. R.

526

4437. Mathematical foundations of geodesy. KÖNIG, K. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Applied Mathematics, IV*," *pp.* 1–11 (1948) *In German.*—The review deals with the geoid, geodetic constants and projections, especially the development and application of the Gausz–Krüger projection, valuable for world maps. W. A. R.

526.1

4438. Theoretical and numerical studies on the approaching derivation of a best-fitting elipsoid for Europe. LEDERSTEGER, K. *S.B. Öst. Akad. Wiss. (Math. Naturwiss. Kl.)* Abt. IIa, **156** (*Nos.* 9–10) 469–566 (1948) *In German.*

526.2

4439. Note on Forsyth method of direct computation of geodesic distances on an oblate spheroid. WASSEF, A. M. *Bull. Géod.* (*No.* 10) 353–5 (1948) *In English.*—The discrepancy given by this method is shown to be due to a numerical error in the analysis. The method is convenient and of general application. W. A. R.

526.3

4440. Applications of the Stokes' gravity formula. BERROTH, A. *Geofis. Pura. Appl.*, **13**, 145–6 (*Nov.–Dec.*, 1948) *In German.*—Stokes' formula applied to calculate deviations from the vertical and the radius of curvature give conditions for improving the geodetic lines of a triangulation. W. A. R.

526.76

4441. A dynamic gravimeter of novel design. GILBERT, R. L. G. *Proc. Phys. Soc. Lond. B*, **62**, 445–54 (*July*, 1949).—A new type of gravimeter is described, which depends for its operation on the change of frequency of the natural vibration of a vertical wire stretched by a weight. The advantages of such an instrument are presented, and a description given of the design which has so far been evolved. The results of laboratory tests and of trials carried out at sea in a submarine are given. A.

526.918 : 621.317.39

4442. Nistri's "Electrocoordinatograph." BOAGA, G. *Tecn. Ital.*, **3**, 332–3 (*Nov.–Dec.*, 1948) *In Italian.*—The instrument described is of the nature of an electrical pantograph. It can be used to reproduce drawings to any scale and at any distance. An adaptable apparatus, it has other uses, notably in photogrammetry. W. A. R.

526.92 : 621.396.9

4443. Some aspects of the influence on geodesy of accurate range measurement by radio methods, with special reference to radar techniques. HART, C. A. *Bull. Géod.* (*No.* 10) 307–52 (1948) *In English.*—A general discussion of the application of distance measurement by radar methods to geodesy based on data obtained with equipment designed for aircraft navigation. The effects of refraction and velocity of propagation are considered and it is concluded that long lines up to 600 km can be measured to an accuracy of 1 part in 20 000. The computation of long lines and methods of radar triangulation are also discussed. J. M. H.

526.92 : 621.396.9 : 621.391.63

4444. An optical radar for surveying. HANSEN, W. W. *Trans. Amer. Inst. Elect. Engrs*, **67**, *Pt I*, 660–3 (1948).—An instrument is described which uses radar techniques to make a survey of terrain. Distances are determined by measuring the transit time of pulses of light travelling between the instrument and a retrodirective reflector placed at the point whose relative position is to be found. Angles are measured by adjusting the position of the optical transmitter to obtain a max. pulse on a c.r.t. A.

527 : 534.88

Sonic navigation system. *See Abstr.* 4592

529.78 : 534.01

4445. On the electromagnetic energy supply of the Favarger secondary clock in the Geodetic Institute of the Eidg. Techn. Hochschule Zürich; a problem of forced oscillations. CHRZASZCZ, R. K. *Mitt. Geodät. Inst. E.T.H. Zürich* (*No.* 3) 5–36 (1948) *In German.*—This clock, together with a master clock, forms the Zürich time service. The energy losses of the secondary clock are compensated by periodic electromagnetic pulses which attract an armature attached to the pendulum. Experiments were carried out to determine photographically the exact conditions of this attraction, as well as the various energy losses, e.g. those due to friction and to bending of the contact springs, etc. A complete empirical equation of motion was obtained and solved numerically. The best working conditions were found for large amplitudes and not too large pulse durations; for the latter the optimum value of 0·85 sec was introduced. A. B.

PHYSICS 53

53.081.5

4446. Comments on the foundation of dimensional analysis. GÖRTLER, H. *Z. Naturforsch.*, **3a**, 668–9 (*Dec.*, 1948) *In German.*—It is shown that all measurable properties of an object satisfy Bridgman's postulate of dimensional analysis. According to this postulate the ratio of the measures of any two intensities of a property must be independent of the unit of measurement. Now the property must possess mutually exclusive characteristics and an asymmetrical transitive order relation must be established between those characteristics to make measurement possible. The ordered characteristics must be made to correspond in a unique manner to an arbitrary set of numbers. These numbers measure the intensity of the property if, and only if it is determined when two

intensity differences are regarded as equal. Any set of numbers which can thus be regarded as a measure of a property satisfy Bridgman's postulate. H. MO.

53.082

4447. A new method of studying relaxation processes. TOLSTOY, N. A. AND FEOFILOV, P. P. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 421–30 (*May*, 1949) *In Russian.*—A new oscillographic method is described for studying relaxation of physical phenomena, based on the use of a non-linear time-base. The method can be applied to processes taking up time intervals from 10^{-6} to 10^{-1} sec. For relaxation phenomena following an exponential law (exp. $-t/\tau$) the value of τ may be determined within a few seconds. A generalization of the method (the "partial times method") permits extension to phenomena which follow any arbitrary law. The method can then be applied to studying the kinetics of luminescence, the photo-effect, the luminous gas discharge, electro-optical phenomena in colloids, the polarization of dielectrics, etc. B. F. K.

53.082.75 : 621.317.31.082.75

4448. General purpose recording apparatus. WHITTLESTON, W. G. AND ZIMAN, J. M. *N.Z. J. Sci. Tech. B*, **29**, 308–17 (*May*, 1948).—Discusses the ways in which hunting can be prevented in electrical recording apparatus, with particular reference to "inching." In this, the motor which drives the recorder ceases to run freely when the balance point is still unattained by a certain amount. From then, until within the "dead" region embracing the balance point, the motor is fed with short pulses of current so that it cannot overshoot. A description is given of a recording apparatus incorporating the phase discriminating relay principle and a simple inching mechanism. J. W. T. W.

FUNDAMENTALS 530.1

530.1

4449. On the principles of nuclear physics. BORGHI, D. C. *Comment. Pont. Acad. Sci.*, **10** (*No.* 1) 145–215 (1946) *In Italian.*—The author claims to give a comprehensive theory of nuclear phenomena. The 5-dimensional formalism is based on Eddington's *E*-numbers. A number of postulates leads to a theoretical determination of the fine structure constant, magnetic moment of proton and neutron, etc. L. P.

530.12

4450. The hypothesis of mass-absorption of gravitational flux and the motion of the perihelion of Mercury. ARMELLINI, G. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 288–94 (*Dec.*, 1948) *In Italian.*—If it is assumed that matter absorbs gravitational flux according to an exponential law in which the coefficient of mass absorption α is very small, the attraction of the sun, assumed uniform and spherical, is very nearly according to the law $a/r^2 + b/r^3$, where a and b are constants and b is small and $\propto \alpha$. Calculation of the orbit of Mercury for the above law of force gives an advance of the perihelion. If this be attributed to mass absorption by the sun of the outward gravitational flux then $\alpha \sim 10^{-16}$ cgs. If the usual relativi theory is invoked then $\alpha \not> 10^{-18}$ cgs. Majora [Abstr. 1521 (1921), 1944–5 (1922)] found expe mentally that α could not exceed 10^{-12} cgs. V. C. A.

530.

4451. Unified field theory in a curvature-free fiv dimensional manifold. BENNETT, J. G., BROWN, R. AND THRING, M. W. *Proc. Roy. Soc. A*, **19** 39–61 (*July* 22, 1949).—Instead of identifyi fields with the curvature of a metric, the prese theory shows that they may be identified with t manner in which the 4-way measuring system of t physical observer O is embedded in a flat 5-dime sional manifold provided that due account is tak of the imperceptibility of the fifth dimension. this system fields are introduced by treating t direction cosines, ${}^{k}l_j$, of the 4 directions of measu ment and of the imperceptible direction as varia functions of position in the manifold. The track an unconstrained body P is taken as a straight li (cosmodesic) in the manifold, but the "projection" it which O observes in his 4-coordinate system is general curved. Thus the equation describing t element ds of P's cosmodesic in O's 4-coordin system (Δx^{μ}) is

$$ds^2 \cos^2\lambda - 2ds \sin\lambda \left\{ \left(\sum_{\nu=1}^{4} {}^{\nu}l_s {}^{\nu}l_{\mu} \right) \Delta x^{\mu} \right\}$$

$$= \left\{ {}^{5}l_{\mu}{}^{5}l_{\nu} - 2{}^{5}l_{\nu} \sum_{k=1}^{5} {}^{k}l_s {}^{k}l_{\mu} + \sum_{k=1}^{5} {}^{k}l_{\mu} {}^{k}l_{\nu} \right\} \Delta x^{\mu}$$

When O applies the variational condition to ds wh expresses the fact that the cosmodesic is straight, concludes that it has a space-time curvature wit distinct components, one dependent upon λ which the angle between the cosmodesic and a univer direction ${}^{5}Q$ and upon ${}^{\nu}l_s$, the other acting equa on all P bodies whatever the value of λ and depend only on ${}^{5}l_{\mu}$. These "accelerations" are shown correspond to electromagnetic and gravitational fie respectively, and the inverse square law of force shown to hold for spherically symmetrical fields both types as a consequence of the condition coherence of the measuring system. When the ca of the positional variation of the ${}^{k}l_{\mu}$ is a heavy bo having a constrained rotation, it is shown to give to the magnetic field that a body of charge equa its gravitation mass would have, without the co sponding electrostatic field. The ${}^{k}l_j$'s are restric by the requirement that the angles between absolute fifth direction, the direction imperceptible for O, and the direction orthogonal to O's measuring directions, are all null.

53

4452. On the Einstein effect. FRANZINI, T. GALLI, M. *Acta Pont. Acad. Sci.*, **10** (*No.* 7) 9 (1946) *In Italian.*—Different authors are not agr as to whether the observations of the spectral l of the sun reveal the existence of the Einstein effe perhaps owing to the difficulties of the measurem The authors have attempted to detect this effect u centrifugal instead of gravitational fields of fo Experiments made with a small Plucker tube rota about an axis 30 cm from it at the rate of 200 r fail to reveal any effect. This may be explained

the fact that between collisions the emitting atoms are not subject to the centrifugal field of force.

V. C. A. F.

530.12

4453. On the relativistic invariation of the canonical field equations and the location of energy, momentum and angular momentum in a field. JAUCH, J. M. *An. Acad. Brasil. Ciênc.*, **20** (*No.* 4) 353–61 (1948) *In English.*—An arbitrary field is considered whose equations are obtained from an invariant Lagrangian depending on the field variables and their first derivatives only. Relativistic invariance of the canonical equations is proved by showing that the infinitesimal Lorentz transformation is a canonical transformation, and an explicit expression is given for the generating function of the transformation. The treatment of momentum and angular momentum follows conventional lines. H. McM.

530.12

4454. Static spherically symmetric solutions in the unitary field theory. PAPAPETROU, A. *Proc. Roy. Irish Acad.*, **52** A (*No.* 6) 69–86 (*Dec.*, 1948).—Static spherically symmetric solutions are obtained of the unitary field equations of Schrödinger [Abstr. 26 (1948)]. The symmetric part of the tensor field g_{ik} behaves asymptotically like the metric tensor. Examination of the energy momentum tensor for weak fields shows that the skew symmetric part does not correspond to the electromagnetic field tensor, but behaves like the potentials of a more complicated field. H. McM.

530.12 : 523.11

4455. Spherically symmetrical models in general relativity. BONDI, H. *Mon. Not. Roy. Astr. Soc.*, **107** (*Nos* 5–6) 410–25 (1947).—Assuming zero pressure and spherical symmetry in a universe of particles, the field equations of general relativity are applied to derive rigorously the equations of motion, which are then compared with the Newtonian approximations. The total energy determines the curvature of 3-space and the ratio of effective gravitating to invariant mass. The Doppler shift contains both the shift due to relative motion of source and observer and the Einstein shift due to difference in potential energy. A. HU.

530.12 : 523.774

An investigation of the Einstein gravitational displacement. *See Abstr.* 4418

530.12 : 530.145

4456. Quantum-theory restrictions on the general theory of relativity. OSBORNE, M. F. M. *Phys. Rev.*, **75,** 1579–84 (*May* 15, 1949).—The limitations set by the uncertainty principle on the measurement of the curvature of space are determined by passing a small test particle around a geodesic triangle. In measuring the curvature of space around a Schwarzschild-solution particle of finite size and physically realized density, it is found that the mass must be at least of the order of 10^4 kilograms, or the curvatures cannot be measured with an accuracy equal to the order of magnitude of the terms in the defining Eqs. $G_{ik} = 0$. For mass points, the lower limit is 10^{-5} g. For smaller masses, the curvatures can only be measured with less accuracy and only over large regions of space. Similar limitations apply to alternative laws of gravitation involving higher derivatives of the metric. It is concluded that in any theory which attempts to unite quantum theory with the general theory of relativity, the relation of the metric to the energy momentum tensor, $G_{ik} - g_{ik}G/2 = -KT_{ik}$, must appear only in the large and in a statistical sense, i.e., for large regions of space and large numbers of elementary particles. A.

530.12 : 531.111.4

4457. The definition of time. LOISEAU, J. *Ann. Franç. Chronom.*, **2** (*No.* 3) 241–54 (1948) *In French.*—A congruence of curves C in Euclidean 4-space is defined by the parameters a^1, a^2, a^3. A point on a curve C is determined by a parameter θ which defines "cosmic time." Points for which θ = constant define a deformable 3-space identified with physical space. Proper time, and more general times $t = f(a^i,\theta)$ are discussed. R. A. N.

530.12 : 531.18

4458. On a possible optical effect of terrestrial motion. GALLI, M. *Acta Pont. Acad. Sci.*, **10,** (*No.* 31) 361–70 (1946) *In Italian.*—Discusses interference between two beams of light, one of which passes through a moving medium. This phenomenon could provide no decisive demonstration of terrestrial motion. R. A. N.

530.14 : 539.152.1

4459. Relativistic terms in the interaction between nucleons in pseudoscalar and vector meson theory. VAN HOVE, L. *Phys. Rev.*, **75,** 1519–23 (*May* 15, 1949).—The second-order interaction between nucleons in the pseudoscalar and vector meson theory is calculated, all terms being taken into account. It is shown that in both cases the exact expression for the interaction caused by virtual exchange of mesons involves contact interaction terms which cancel the well-known direct coupling terms of the Hamiltonian. The remaining interaction is essentially different from the expressions given by usual derivations. Its singularity for small separations r of the nucleons, usually obtained to be in r^{-3} for pseudoscalar and vector fields, is reduced for the former and not for the latter, so that no singularity can be removed by a mixture of the mentioned fields. For pseudoscalar mesons, all interaction terms are $\propto$ some power of the nucleon velocity, whereas for vector mesons there is a non-vanishing static approximation in r^{-1}. It seems impossible from the present treatment to draw precise and reliable conclusions about the deuteron. A.

530.145

4460. On the generalised transformation functions. TANIKAWA, Y. *Progr. Theor. Phys.*, **1,** 12–20 (1946) *In English.*—The functions are defined and applied to the Tomonaga formalism of the quantum theory of fields. [Abstr. 2949 (1949)]. M. R.

530.145

4461. On the theory of elementary particles. I. YUKAWA, H. *Progr. Theor. Phys.*, **2,** 209–15 (*Nov.–Dec.*, 1947) *In English.*—A generalization of the field theory of interaction terms leads to operator equations for the field which, for the electromagnetic case, are those of Snyder [Abstr. 2413 (1947)]. The suggestion is made, but not elaborated, of quantizing using a density matrix. G. J. K.

530.145

4462. On the scattering of fast particles of spin one by atom nuclei. KAR, K. C. *Indian J. Phys.*, **22,** 249–52 (*June*, 1948).—The wave-statistical theory of scattering due to spin-spin developed earlier [Abstr. 350 (1948)] is extended and applied to particles of spin 1. The resulting formula differs from that of Massey and Corben in the numerical factor in the relativity correction. G. J. K.

530.145

4463. On the Born's successive approximation in the theory of atomic collisions. NOGAMI, M. *Progr. Theor. Phys.*, **3,** 356–61 (*Oct.–Dec.*, 1948) *In English.*—See Abstr. 1429 (1948).

530.145

4464. On Feenberg's perturbation formula. FESHBACH, H. Letter in *Phys. Rev.*, **74,** 1548–9 (*Nov.* 15, 1948).—Feenberg's formula [Abstr. 2704 (1948)] is derived directly from the eigenvalue problem by a method of successive approx. The original problem is $H\psi = E\psi$; and if H_{mn} are the matrix elements of H, and A_m are the amplitudes of the expansion in an orthonormal set of functions, the equations now solved are $(E - H_{mn})A_m = \Sigma H_{mn}A_n$, where Σ is taken over $m \neq n$. L. S. G.

530.145

4465. Quantum statistics and continuum physics. LOHR, E. *Z. Naturforsch.*, **3a,** 625–36 (*Dec.*, 1948) *In German.*—An argument used in previous papers to derive the Wien displacement law [Abstr. 648 (1937)] and the Planck radiation law [*Z. Phys.*, **116,** 454 (1940)] is here used to derive the de Broglie relation and the Fermi–Dirac and Bose–Einstein distribution laws. P. M. D.

530.145

4466. On the wave equation with small quantum numbers. LANGER, R. E. *Phys. Rev.*, **75,** 1573–8 (*May* 15, 1949).—The determination of the "eigenvalues," and the normalization of the "eigenfunctions" of the one-dimensional wave equation, with a potential energy that has a single minimum, is customarily based on the use of the so-called phase integral and W.K.B. formulae. These formulae are asymptotic in character. As they have usually been applied, they accordingly lead to conclusions which can be regarded as established only when the respective quantum numbers are sufficiently large. This restriction has been unfortunate. For on the one hand, the cases of small or moderate quantum numbers are often peculiarly interesting while, on the other hand, the phase integral formulae have been found by trial, at least in a variety of simple cases, to give surprisingly good results even in the lower quantum number range. It is shown in this paper how the asymptotic method should be applied when small or moderate quantum numbers are in question. In the case of the "eigenvalues," the characteristic equation appropriate to the lower range is derived, and a comparison of this new equation with the familiar one based on the phase integral is made. It is thus theoretically established that under certain very liberal conditions upon the potential energy the older method does give good approximations. In the special case of the harmonic oscillator the two equations are, in fact, identical. For the normalization of the "eigenfunctions" a method which h been used in principle by Furry is applied. It however, framed in a manner appropriate to t smaller quantum number range. Formulae are giv for the normalized "eigenfunctions" over the seve intervals of the variable, over the critical inter which includes the minimum of the potential ener and the turning points, as well as over the interv remote from the turning points. In the special ca of the harmonic oscillator, the method here us gives certain exact—not merely asymptotic—resul These, therefore, supply a basis for the appraisal the corresponding results that are obtainable by oth means.

530.145 : 537.1

Quantum theory of the point electron. *See Abs* 4749

530.145 : 537.133 : 539.1

4467. On the magnetic moment of the proton a the neutron. URBAN, P. *S.B. Öst. Akad. Wis* (*Math. Naturwiss Kl.*) Abt. IIa, **156** (*Nos* 5–6) 287– (1948) *In German.*—The magnetic moments are ca culated for a vector meson field using an expansi of the field in spherical waves, and a cut-off at hi momenta. The correct moment is obtained with meson mass $\sim 150\,m$, if the interaction constant that given by Kemmer. G. J.

530.145 : 538

4468. Interaction energy in quantum field theor GREEN, A. E. S. Letter in *Phys. Rev.*, **74,** 15 (*Nov.* 15, 1948).—Fock's quantum electrodynami uses a transformation to eliminate the auxilia conditions and a single time formulation, resulti in the explicit appearance of the Coulomb energ The transformation can be extended to give t dynamic interaction energy as well in part, and t Breit formula can be obtained. G. J.

530.145 : 539.152

4469. On the effect of the field reactions on t interaction of mesotrons and nuclear particles. I TOMONAGA, S. *Progr. Theor. Phys.*, **2,** 63–70 (*March June*, 1947) *In English.*—Deductions are made fro earlier results on intermediate and strong couplin The low experimental meson scattering is almo obtained, suggesting that it is due to this reactio term. With intermediate coupling n–p or p– scattering results would give an apparent meson ma from the effective range > the actual mass, owing t the deviation of the potential from the $e^{-\kappa r}/r$ form Again proton isobars would be just observable, a might be invoked to explain at least one heav meson photograph. If these isobars exist, nuclea excitation may be followed by slow meson emissio with a relatively large cross-section. G. J. F

530.145 : 539.154

4470. The charge density and magnetic moments the nucleons. SLOTNICK, M. AND HEITLER, W. *Phy Rev.*, **75,** 1645–63 (*June* 1, 1949).—Using pseudo scalar meson theory, the behaviour of a single-nucleo system in an electric field is studied. From the electr static interaction, the interaction between neutron and electrons is computed. From the spin-orb interaction, the magnetic moments of neutron an proton are computed. The calculation is carried ou

relativistically, with nucleon and pseudoscalar meson fields both subjected to second quantization. The Hamiltonian of the nucleon-meson system is diagonalized to second order in the coupling parameters by two canonical transformations, and transitions induced by the electric field between single-nucleon states are investigated. For pseudoscalar coupling of 282 e.m. mesons, estimating the coupling constants for charge-symmetric theory from the observed singlet neutron-proton scattering length (using static nuclear forces), it is found that the volume integral of the neutron-electron interaction potential $\sim -14\,\mathrm{keV}\times(4\pi/3)(e^2/mc^2)^3$, and that μ_P and μ_N are about 1·7 and −5 nuclear magnetons respectively. Results are also given for pure charged theory. Pseudovector coupling is compared to pseudoscalar coupling, and is found to give the same magnetic moments, but a logarithmically divergent neutron-electron interaction. The influence of the contact interaction term is discussed. The results are compared with those of "non-relativistic" methods and with experimental values, and the neutron-electron interaction is computed approximately for several types of mesons with an improved non-relativistic method. Charge renormalization and the approximate distribution of the charge cloud around a neutron are discussed. The pseudoscalar meson contribution to the Lamb Shift of the 2*S* H level is estimated as +0·08 Mc. A.

530.145 : 539.18

4471. On the quantum theory of radiation damping and the lifetime of the meson. TANIKAWA, Y. *Progr. Theor. Phys.*, **3**, 38–53 (*Jan.–March*, 1948) *In English.*—The theory is applied to calculate the photo-mesic effect, and also the lifetime of the neutral meson by the usual decay process. The lifetime is also calculated assuming that the meson decays by an indirect process in interaction with a proton, with the virtual creation and β-decay of a negative proton. Using the radiation damping a lifetime of 10^{-47} sec is obtained for this second process, whereas 10^{-6} sec is obtained by perturbation theory. G. J. K.

530.145 : 539.18

4472. Divergence difficulty and mixed meson theory. ARAKI, G. Letter in *Phys. Rev.*, **74**, 985–6 (*Oct.* 15, 1948).—The divergences of the magnetic moments and the interaction energy of 2 nucleons can be removed in meson theory by choosing a suitable mixture of pseudoscalar and pseudovector fields of different masses, but not with 2 other types of meson. The β-decay constants then require a lifetime of 10^{-6} sec for the pseudoscalar meson. G. J. K.

530.145 : 539.18

4473. On the magnetic moment of nucleons according to the pseudovector meson theory. ARAKI, G. Letter in *Phys. Rev.*, **74**, 986 (*Oct.* 15, 1948).—Previous work [Abstr. 4472 (1949)] is continued, and criteria are evolved for various mixed meson theories. There are 8 possibilities, but only 2 of these permit the elimination of certain divergences. The discussion involves the consideration of 3 kinds of pseudovector mesons. L. S. G.

530.145 : 539.18

4474. On the wave-equations of a particle of spin ½ with several masses. POTIER, R. *C.R. Acad. Sci., Paris*, **227**, 1146–7 (*Nov.* 29, 1948) *In French.*—A system of equations for a particle of spin ½ and 2 mass values is shown to be satisfactory. The extension to obtain many mass values is outlined. G. J. K.

530.145.6

4475. On the meson pair theory of nuclear forces. II. NOMA, S. *Progr. Theor. Phys*, **3**, 54–73 (*Jan.–March*, 1948) *In English.*—See Abstr. 2978 (1949). Forces are calculated for a pair theory with mesons of spin ½ with all types of interaction. The results are consistent with those of Marshak [Abstr. 2519 (1940)]. It is concluded that a pseudovector coupling alone is sufficient to account for the experimental data, provided the interaction constant, ratio of the masses of the charged and neutral mesons and the cut-off radius are chosen correctly. G. J. K.

530.145.6

4476. A note on an analogy regarding operators in Dirac's wave equation for the electron. GUPTA, S. *Proc. Nat. Inst. Sci., India*, **14**, 311–14 (*Aug.*, 1948).—The group of 16 Dirac operators is divided up to form tensors of orders ranging from 0 to 4 in two different ways. The relations between the two sets of tensors is shown to be formally equivalent to a Lorentz transformation. E. P. G.

530.145.6

4477. Relativistic field theories. CHANG, T. S. *Phys. Rev.*, **75**, 967–71 (*March* 15, 1949).—The study of the change of the Schrödinger wave functionals on space-like surfaces as the surface changes is formulated simply. In this formulation, let S be any space-like surface with the curvilinear co-ordinates u, introduce $\langle q(u)S|\rangle$ as the Schrödinger functional on it, with the nature of the functions $q(u)$ not specified for the moment, and write the Schrödinger equation (1) as $i\hbar\{\langle q(u), S'|\rangle - \langle q(u), S|\rangle\} = J\langle q(u), S|\rangle$, where S' is a surface slightly different from S, and J is an operator operating on $q(u)$ and depending on S, S', and the choice of their co-ordinates u. Obviously, the only necessary conditions for J is that J is Hermitian and that (1) is integrable. To get a theory resembling the existing ones, it is required further that if one constructs the expectation value of a certain field quantity at a point P from $\langle q(u), S|\rangle$, S being a surface passing through P, the expectation value is independent of choice of S and its co-ordinates u, and satisfies certain differential equations. When these differential equations follow from a Lagrangian principle, an expression for J was effectively given by Weiss. His work is given in a complete form and the proof of the satisfaction of all requirements completed. Finally, by a simple transformation on the wave functions and the observables, Weiss's formalism is deduced from Tomonaga's formalism. As a consequence, it is pointed out that Tomonaga's formalism will encounter essentially the same difficulties as the orthodox Heisenberg–Pauli formalism. A.

530.145.6

4478. Exact solution of eigenvalue problems arising in connection with the study of certain hydrodynamical or quantum-mechanical wave phenomena. GROEN, P. *Appl. Sci. Res.*, **A1** (*No.* 3) 225–36 (1948) *In English.*—

Analytical solutions are given of the differential equation

$$d^2\phi/dx^2 + \{a[\cosh(x/c)]^{-2} + b[\sinh(x/c)]^{-2} - m^2\}\phi = 0$$

Eigenvalues and eigenfunctions are discussed for various boundary conditions. L. P.

530.145.6 : 538.1

4479. On the electromagnetic properties of nucleons. II. KANAI, E., KOBAYASI, M. AND KOKAJI, S. *Progr. Theor. Phys.*, **2**, 151–7 (*July–Oct.*, 1947) *In English.*—An estimate is made of the magnetic and electric polarizability of a nucleon by finding its energy and that of the associated meson field in a static electromagnetic field, subtracting infinite terms following Weisskopf's positron theory. Owing to the subtraction process no static magnetic moment is obtained. It is argued [see Abstr. 1317 (1949)] that the usual identification of the energy term for the magnetic moment is doubtful, and the magnetic moment should be obtained from factors in transition probabilities in which it should occur. G. J. K.

530.145.6 : 538.1

4480. On the electromagnetic properties of nucleons. III. KANAI, E. AND KOBAYASI, M. *Progr. Theor. Phys.*, **2**, 179–86 (*Nov.–Dec.*, 1947) *In English.*—Continuation of Abstr. 1317 (1949). The magnetic moment of a nucleon is obtained by calculating the Stern–Gerlach effect to first order. This gives $M \sim -(4/3\pi)(eg^2/\mu c^2)(m/\mu)$, so that, with $(m/\mu)=10$, the coupling constant $(g^2/\hbar c) \sim 1/44$ which is small. G. J. K.

530.145.6 : 539.152.1

4481. Symmetrical meson theory of nuclear forces. WU TA-YOU AND FOLEY, H. M. *Phys. Rev.*, **75**, 1681–6 (*June*, 1949).—The static and the first order non-static nucleon potential on the basis of the Møller–Rosenfeld–Schwinger mixture of a vector meson of mass κ_0 and a pseudoscalar meson of mass 315 m_e is assumed. One relation among the coupling constants is postulated to remove the inadmissible singularities in the tensor force term. The coupling constants are then determined by means of the binding energy of the deuteron and the total cross-section for slow neutron scattering. The potentials so determined are used to calculate the "effective range" r_0 for the triplet and the singlet states (proton-proton scattering), the quadrupole moment Q of the deuteron, and the cross-section σ and $\sigma(170°)/\sigma(90°)$ for proton-neutron scattering at 100 MeV. The value $\kappa_0 = 1{\cdot}5\times315\ m_e$, while giving somewhat too low values for the r_0's, yields entirely too small a Q and too large a ratio $\sigma(170°)/\sigma(90°)$ whereas the value $\kappa_0 = 2\times315\ m_e$, while giving better values for Q and $\sigma(170°)/\sigma(90°)$ yields much too small values for the r_0's. It appears that this failure to account for both the high energy and the low energy scattering data is characteristic of any potential having the exchange properties of the symmetrical meson theory. A.

530.145.6 : 539.18

4482. On Wentzel's method in the meson theory. MIYAZIMA, T., TATI, T. AND TOMONAGA, S. *Progr. Theor. Phys*, **3**, 26–37 (*Jan.–March*, 1948) *In English.*—The method is applied to a symmetrical vector meso theory. G. J.

530.145.6 : 539.1

4483. On the analysis of nucleon-nucleon scatteri experiments. CHEW, G. F. AND GOLDBERGER, M. *Phys. Rev.*, **75**, 1637–44 (*June* 1, 1949).—A metho of perturbation calculation, especially adapted nucleon-nucleon scattering problems, is describe Any contribution to the energy of the system whic is relatively small where the nuclear potential large may be treated as the perturbation. 2 princip examples are discussed. (1) Energy as the pertu bation: An expansion of the phase shifts in powe of the energy is written down which extends earli results of Schwinger, Blatt and Jackson. (2) T Coulomb field as the perturbation in the proto proton problem: expansions are given which rela the nuclear phase shifts in a combined nuclear an Coulomb field to the corresponding phase shifts f a purely nuclear problem. Attention is confined central forces throughout.

530.145.

4484. Calculation of eigenfunctions and eigenphas for a continuous *P*-spectrum in the case of a Yukav potential. HANSSON, I. *K. Fysiogr. Sällsk. Lu Förh.* (*No.* 7) 178–95 (1948) *In English.*—Hulthen method of calculating scattering phases for *S*-stat [Abstr. 492 (1945)] is developed for use with *P*-state The variation is carried through for the central meso potential, for various trial functions with 1, 2 3 parameters, and a comparison made with the exa solution where possible, for a range of energy value The phase values are surprisingly accurate (to 0·1 even with the simplest trial function, and the wav functions are correct to usually $< 1\%$ of their greate value, over a large range. G. J.

530.145.

4485. On generalised *E*-numbers. LANDSBER P. T. *Proc. Lond. Math. Soc.* (*Ser.* 2) **49** (1947). A class of algebras generated by *S*-symbols satisfyi $S_jS_k = -S_kS_j$ $(j,\ k = 1, 2, \ldots n)$ is defined a investigated, the square of an *S*-symbol being ze or unity. The relationship with matrices and t transformation properties of Eddington's *E*-numbe are obtained.

530.145.

4486. Further investigation on Heisenberg's chara teristic matrix. HU, N. *Proc. Roy. Irish Aca* **52 A** (*No.* 5) 51–68 (*Nov.*, 1948).—For a system co sisting of a fixed number of particles the closed stat can be obtained by analytic continuation of t *S*-matrix. The method is extended to a system which the number of particles is not fixed. T solution in this case, however, contains free waves negative energy particles, so that it cannot repres a permanent closed state. H. Mc

530.145.

4487. The *S* matrix in quantum electrodynami DYSON, F. J. *Phys. Rev.*, **75**, 1736–55 (*June* 1, 1949). The covariant quantum electrodynamics of Tomonag Schwinger and Feynman is used as the basis for general treatment of scattering problems involvi electrons, positrons and photons. Scattering pr

cesses, including the creation and annihilation of particles, are completely described by the S Matrix of Heisenberg. It is shown that the elements of this matrix can be calculated, by a consistent use of perturbation theory, to any desired order in the fine-structure constant. Detailed rules are given for carrying out such calculations, and it is shown that divergences arising from higher order radiative corrections can be removed from the S matrix by a consistent use of the ideas of mass and charge renormalization. Not considered in the paper are the problems of extending the treatment to include bound-state phenomena, and of proving the convergence of the theory as the order of perturbation itself tends to ∞. A.

530.145.7 : 539.185

4488. The analysis of neutron-proton scattering with tensor forces. CHRISTIAN, R. S. *Phys. Rev.*, **75**, 1674–7 (*June* 1, 1949).—The expansion in energy of the cross-section for central force scattering proposed by Chew and Goldberger [Abstr. 4483 (1949)] is extended to tensor force scattering. The change due to the addition of tensor forces, in both the effective range and in the shape dependent coefficient, is shown to be small. Hence, as has been previously shown by Blatt and Jackson for central forces, scattering below 10 MeV is practically independent of the potential shape assumed and is completely characterized by the scattering length and effective range. A.

530.15

4489. Isolated systems, laws of elementary force, principle of action and reaction. PERUCCA, E. AND RADICATI, L. A. *Atti Accad. Naz. Lincei* (*R.C. Cl. Soc. Fiz. Mat. Nat.*) **4**, 643–5 (*June*, 1948) *In Italian.*—The Newtonian principle of action and reaction is discussed briefly. Elementary laws of force, e.g. gravitational, electrostatic, electromagnetic, etc., are then discussed and it is pointed out that these do not all satisfy the principle of action and reaction. The simplest example is that of the force on an electron, or current element, in a magnetic field. The limitations of the principle are explicitly specified. L. S. G.

530.162 : 539.152.1

4490. Heisenberg principle of indeterminacy. BLEKSLEY, A. E. H. *S. Afr. J. Sci.*, **1**, 64 (1947).—Application of the Heisenberg principle indicates that the indeterminacy of the kinetic energy of an electron existing within a deuteron is 27 MeV, which exceeds the accepted depth of the potential shell of the deuteron. This suggests that an electron cannot exist within the deuteron, in agreement with other lines of argument. A similar argument leads to the view that the least mass for a particle which can be defined as lying within the potential well of the deuteron is $\sim 1/14$ of the mass of the proton, or ~ 130 times that of the electron, and therefore corresponds with the mesotron. The inexactitude of the kinetic energy of a proton or neutron within a nucleus must be $> 2 \cdot 3A^{-2/3}$ MeV (where A is the mass of the nucleus). This must correspond with the width of the proton or neutron energy-levels within the nucleus. B. A.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.132

4491. Transmission accuracy of linkage mechanisms. WUEST, W. *Technik*, **3**, 315–19 (*July*, 1948) *In German.*—The accuracy of the linkage mechanisms of the type used in Bourdon gauges is examined theoretically and by measurements on a model. Deviations from proportionality are due to 2nd and 3rd order effects, but these may be kept small by appropriate design. H. J. H. S.

531.259

4492. Calculation of the deformation of a plate supported on an elastic medium. STANKIEWICZ, L. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 339–44 (*Dec.*, 1948) *In Italian.*—The calculation requires a knowledge of the value of the integral

$$\int_0^\infty \int_0^\infty \frac{\sin ux \sin vy \, du dv}{uv[(u^2 + v^2)^2 + 1]}$$

A method is described for evaluating this integral numerically and a table of values is given for x and y in the range $(0, \infty)$. L. S. G.

531.261.2 : 530.19

4493. On the discontinuities in the derivatives of the potential of a simple sheet. MANACORDA, T. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 14–19 (*July–Aug.*, 1948) *In Italian.*—The Newtonian potential has singularities at point, line or surface distributions of mass, these corresponding to regions of infinite volume density of mass. The discontinuities arising in the first and second derivatives for the case of a surface distribution are well known. The author uses the notation of Buralli Forti and Marcolongo and the technique used by Caldonazzo to examine the discontinuity in the third partial derivatives of the potential across the generating surface. In general, all these derivatives are discontinuous, the discontinuity depending upon the geometrical and material characteristics of the surface, and their derivatives. S. M.

531.31

4494. On the impulsive motion of a holonomic system subject to simultaneous unilateral constraints. CAIANIELLO, E. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) 706–14 (*June*, 1948) *In Italian.*—Assuming smooth, rigid, perfectly elastic constraints, the author shows that the velocity vector after impulse of a point P subject to an impulse at O may be obtained by reflection of the velocity vector before impulse in a certain "hypersurface of constraint" at O, provided that such hypersurfaces cut orthogonally at O. An earlier discussion due to Cattaneo [*Atti Accad. d'Italia*, **14** (1943)] is held to be faulty. V. C. A. F.

531.314

4495. Gauss' principle of least constraint applied to the non-holonomic dynamics of a rigid body. DE DONDER, TH. AND MELCHIOR, P. *Bull. Acad. Roy. Belge Cl. Sci.*, **34** (*No.* 12) 966–8 (1948) *In French.*—The equivalence of Gauss' principle of least constraint with Lagrange's principle of least action is illustrated by considering the rolling motion of a hoop. G. C. McV.

531.36

4496. On a new integrable case of the movement of a solid body around a fixed point. NADOLSCHI, V. L. *Ann. Sci. Univ. Jassy*, **30**, 43–74 (1944–47) *In French.*—Describes a new method of finding the motion of a solid body about a fixed point. The first chapter describes the method of solving the relevant differential equations. Essentially it consists of finding a transform which reduces the general second order differential equation (linear or non-linear) to an equation with constant coefficients. The general form of the problem, using the Euler equations, is stated in the second chapter, and followed in the third chapter by several particular cases which can be reduced to this general form. G. O. B.

531.41

4497. On the increase in tension in a belt drive when the dependence of the friction coefficient on the velocity is allowed for. PISTOLESI, E. *Acta Pont. Acad. Sci.*, **10** (*No.* 11) 117–26 (1946) *In Italian.*—Theory of belt drive with an elastic belt is developed on the assumption that the belt-pulley friction varies as the nth power of the slip velocity. Coulomb friction is ignored. T. S. E. T.

531.51

4498. On the potential of ellipsoids. ZAGAR, F. *Comment. Pont. Acad. Sci.*, **10** (*No.* 12) 407–29 (1946) *In Italian.*—If $k^2 = \varepsilon^2 - \eta^2(1-\varepsilon^2)(1-\eta^2)^{-1}\sin^2\lambda$, $\sigma = r - s - n - 1$, $r = 1, 2, 3, \ldots$, $s = 0, 1, \ldots$, $r-1$, $n = 0, 1, \ldots$, $r - s - 1$, a study of the function $F_{rsn} =$

$$\int_0^{2\pi} \cos^{2\sigma}\lambda d\lambda \int_{-\frac{1}{2}\pi}^{\frac{1}{2}\pi} (\cos\phi)^{2r-2s-1}(1-k^2\cos^2\phi)^{-r-\frac{1}{2}} d\phi$$

is of interest in the development of the gravitational potential of an ellipsoid at an external point, or of the mutual potential energy of 2 ellipsoids, in ascending powers of the two eccentricities ε, η of the ellipsoid. The coeffs. of these powers are obtained in finite form and an example given. V. C. A. F.

531.53

4499. A simple roll-band flexible pendulum of which the period with larger amplitudes and with small lengths of band remains approximately constant. MEISSER, O. *Geofis. Pura Appl.*, **10** (*Nos* 3–4) 81–101 (1947) *In German.*—The period of the pendulum as a function of the co-ordinates of the centre of gravity is investigated and expressed in a series of powers of the amplitude. The condition that the period should be independent of amplitude is then obtained, and the conditions required for a "minimum form" of pendulum are also determined. Numerical values are given to demonstrate the advantages of the minimum roll band linkage pendulum over former types of pendulum. G. G.

531.539.2

4500. Cardanic motions of a bi-pendulum. BORDONI, P. G. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 147–54 (*Sept.–Oct.*, 1948) *In Italian.*—The conditions are established under which the displacements of the 2 parts are equal and of the same or of opposite signs. An expression for the period is given in terms of an elliptic integral, and the theoretic conclusions are verified experimentally. L.

531.

4501. The problem of escape from the earth rocket. MALINA, F. J. AND SUMMERFIELD, M *J. Aero. Sci.*, **14**, 471–80 (*Aug.*, 1947).—The esca problem is reconsidered in the light of propellan available as a result of wartime development. T pertinent characteristics of these propellants are giv and the resulting performance of several types rockets estimated. It is shown that with the pr pellants now available it is not feasible to design single-stage rocket capable of escape. Escape with multi-staged rocket capable of carrying a small pa load does, however, appear possible. It is estimate that a 10-stage acid-aniline rocket of 70 ft leng and 7 ft diameter could escape with a 10 lb pay loa In general the effects of the principal design variabl are shown, and useful estimates based on rece experience of such parameters as the required stru tural weight to gross weight ratios are given. A. M.

531.5

4502. Rocket motors. CHRISTENSEN, H. AN RONÆSS, E. *Forsvarets ForsknInst. Årb.*, 241–6 (1947) *In Norwegian.*—General principles of action rocket (jet) motors with solid fuel are stated, spee and acceleration formulae are derived and the g efflux velocity is given. Properties of solid fuels a discussed and details of some modern fuels (ballistit galcite, Perpulver) are given. Combustion is di cussed and some modern rockets are described an illustrated. J. A. V

531.57

4503. The ballistic effects of bore resistanc CORNER, J. *Quart. J. Mech. Appl. Math.*, **2**, 232–4 (*June*, 1949).—Resistance to motion of a projecti down the bore of a gun alters the pressure an velocity attained, but is usually neglected in ballist theory. It is shown that weighting factors can b calculated for each point in the shot travel, such tha the effect of a bore resistance with any desired depe dence on travel can be quickly found by integratio of the product of weighting factor and resistanc The method fails if the resistance is sufficient to sto the shot for a time, and initial engraving resistanc is therefore not a special case of this solution.

MECHANICAL MEASUREMENTS 531.7

531.7 : 533.5 : 536.

Mechanical instruments at the Physical Society Exhibition. *See Abstr.* 4732

531.71

4504. A review of methods for coating-thickne determination. BENNETT, R. S. *J. Sci. Instrum Phys. Ind.*, **26**, 209–16 (*June*, 1949).—An account i given of various methods of non-destructively measu ing the thickness of thin coatings on bases of a differen material, usually mild steel. In particular, two instru ments which have been recently developed for us

n the plating industry are described, and results are compared. A.

531.717 : 537.542

4505. Optical method of determining thickness of Geiger tube windows. BROWN, F. W., III. AND WILLOUGHBY, A. B. *Rev. Sci. Instrum.*, **19**, 820–1 (*Nov.*, 1948).—The banded spectrum of white light formed by reflection from the mica window with an angle of incidence (r) of 10°, is compared in a direct-vision pocket spectroscope with the Hg spectrum (of white fluorescent light) and the number (n) of interference fringes between the yellow ($\lambda_1 = 577\ m\mu$) and blue ($\lambda_2 = 436\ m\mu$) Hg lines is counted. Then the surface density of the window, $W = \left[\frac{\rho\lambda_1\lambda_2 10^{-4}}{2\mu \cos r\,(\lambda_1 - \lambda_2)}\right] n = 0{\cdot}163\ n$ m/cm², where ρ = density of mica (2·85 g/cm³), μ = index of refraction (1·58). A. O. S.

531.72

4506. The gas-permeability method of measuring the specific surface of finely-divided materials. SVENSSON, J. *Jernkontor. Ann.*, **133** (*No.* 2) 33–86 (1949) *In Swedish.*—Experiments with the gas-permeability method have given new results confirming the theoretical basis of the method, a new equation being obtained for the permeability of a bed of finely-comminuted material, which is found to be a linear function of the mean pressure in the bed, the specific surface being independent of the porosity and the kind of gas used. The mean error of the method was found to be ± 3·2%. In grinding tests the specific surface was found to increase approximately linearly with the grinding time up to 7½ hr. I. A.

531.724 : 539.16

4507. A comparison of the direct and indirect radioactive methods for determining the surface area of a strontium sulphate precipitate. SINGLETON, R. H. AND SPINKS, J. W. T. *Canad. J. Res. B*, **27**, 238–57 (*April*, 1949).—The specific surface of a $SrSO_4$ precipitate, as determined by the direct radioactive method using Sr^{90}, was found to be 12 800 cm² per gm. The specific surface of the same precipitate was also determined by the indirect method using ThB. Specific surfaces of 30 800 and 21 300 cm² per gm were obtained using ThB separated, from $ThNO_3$, by the chemical separation and emanation methods, respectively. The factor of approx. 2 between the direct and indirect methods indicates that Paneth's theories, while probably correct in the main, may require some modification. A.

531.724 : 541.183 : 539.264

4508. A comparison of the X ray diffraction and nitrogen adsorption surface areas of carbon blacks and charcoals. ARNELL, J. C. AND BARSS, W. M. *Canad. J. Res. A*, **26**, 236–42 (*July*, 1948).—The surface areas of a number of carbon blacks and activated charcoals were determined by low temp. N adsorption and by broadening of diffraction lines. All samples of activated charcoal had specific surfaces of the order 2 500 to 3 000 m²/cm³. It is suggested that the adsorbent is the surface of individual small crystallites, and that activation consists in making these surfaces available to the adsorbate. L. G. C.

MECHANICS OF FLUIDS 532

532.123 : 534.321.9

4509. Measurement of shear elasticity and viscosity of liquids at ultrasonic frequencies. MASON, W. P., BAKER, W. O., MCSKIMIN, H. J. AND HEISS, J. H. *Phys. Rev.*, **75**, 936–46 (*March* 15, 1949).—The range of shear wave measurements in liquids has been extended up to 60 Mc/s by observing the effect, on a series of shear waves in a fused quartz rod, of terminating the rod by a thin layer of a liquid. The shear wave in the rod is altered in magnitude and phase by the boundary layer impedance of the liquid. By observing the reflection loss and the change in phase caused by the liquid layer, a measure is obtained of the shear impedance of the liquid. By employing a fused quartz rod for which the shear wave strikes the reflecting surface at an angle from the normal of about 79 degrees, the effect of the shear wave impedance on the boundary is greatly enhanced and a more accurate measurement obtained. Both the torsional crystal and high frequency shear wave techniques applied to polyisobutylene and poly-α-methylstyrene liquids, show that there are two main relaxation frequencies in these liquids. At frequencies under 100 kc/s the shear stiffness is in the order of 3×10^7 dynes/cm², while in the high megacycle range it has increased to 5×10^9 dynes/cm². The low shear elasticity appears to be associated with a composite motion of molecular rotation and translation that allows a configurational change to occur from the most probable chain shape. When the shear stress is removed, the molecule quickly returns to its most probable shape. This results in a low shear stiffness. At high frequencies this motion cannot take place, and the shear stiffness is determined by motions within single potential wells, and the value approaches that for a crystal. It is shown that the dispersion for longitudinal waves measured recently is primarily due to the shear mechanisms investigated. A.

532.13

4510. Reflection and refraction of plane shear waves in viscoelastic media. O'NEIL, H. T. *Phys. Rev.*, **75**, 928–35 (*March* 15, 1949).—The shear elasticity and viscosity of liquids have been measured at ultrasonic frequencies by utilizing plane shear waves in an elastic solid and measuring the reflection loss and phase shift caused by reflection at a plane interface of the solid and a liquid. The first measurements of this type involved normal incidence. In a recent modification of the method, oblique incidence results in an enhanced effect. This paper derives the theoretical relations between the constants of the two media, the complex reflection coefficient and the angle of incidence. The theory describes some of the general properties of reflected and refracted shear waves in isotropic visco-elastic media. A.

532.13

4511. Variation of the viscosity of liquids with temperature. KOBEKO, P. P., KUVSHINSKI, E. V. AND SHISHKIN, N. I. *Petroleum*, **10**, 254–5 (1947).—An analysis of the data on temp. variation of η of numerous liquids of varying structures shows that attempts to represent the variation of η by 2 intersecting straight lines of the complete curve, $\log \mu =$

$\varepsilon(1/T)$, are not permissible. Theories of the liquid state based on η relationships and on classification of liquids as simple and associated must take into account such experimental data. B. A.

532.13

4512. Molecular weight, density and viscosity of liquefied gases. RUDENKO, N. S. *J. Tech. Phys., USSR*, **18**, 1123–6 (*Sept.*, 1948) *In Russian.*—It was found that for the homologous series of organic compounds there is a relationship between molecular weight and viscosity according to which both increase together, viscosity increasing more rapidly with the corresponding isomers than with normal compounds. For the series with the group CH_2 as increment, the relationship has the form $\eta/M^2 = \text{const.}$, for some substances (pentane, decane, octane), the form $\eta/M = \text{const.}$ (where η is the viscosity, M the molecular weight). To compare the coefficients of viscosity at boiling point or for equal $d\eta/dT$ is not quite correct, as these points do not indicate corresponding states. The author therefore compares the values obtaining at equal reduced temps., the substances then being really in corresponding states. By introducing the concept of the "critical viscosity" the above empirical relations could be obtained. The relation between density and viscosity was found to be linear only within a narrow temp. range near the melting point. B. F. K.

532.133

4513. Viscosity of liquids and temperature. BANERJI, B. K. Letter in *Curr. Sci.*, **17**, 214–15 (*July*, 1948).—Guided by experimental data obtained for many liquids the author proposes an empirical equation $\log(\log \eta) = A - BT$, as a relation between η, the viscosity coefficient in millipoises and T, the absolute temp. A table of values for various liquids is given to show that observed and calculated values are with few exceptions in close agreement in the range 0–100°C. In the case of H_2O, observed and calculated values agree closely in the range 20–100°C, and in the case of D_2O the agreement is close in the range 5–35°C. G. G.

532.133 : 534.221

4514. The second viscosity of liquids. LIEBERMANN, L. N. *Phys. Rev.*, **75**, 1415–22 (*May* 1, 1949).—The second coeff. of viscosity is concerned with the viscous forces generated by compression (or dilatation). In the absence of knowledge of its magnitude in liquids it has been customary in hydrodynamics to assume that the coefficient of dilatational viscosity, n', could be approximated by the ideal gas value $n' = -2n/3$, where n is the coeff. of shear viscosity. A method has been developed for obtaining values for the dilatational viscosity which is based on Eckart's theory of acoustical streaming; the non-periodic motion of the fluid in the vicinity of a sound source is dependent on the two coeffs. of viscosity. Values for the coeff. of dilatational viscosity for a variety of organic liquids and for H_2O are given. The coeff. of dilatational viscosity was found to be positive in sign and $>$ the shear viscosity. For example, the dilatational viscosity of H_2O was found to be 2·4 centipoise and that for CS_2 $>$ 200 centipoise. There is no correlation between the magnitude of the shear and dilatational viscosities for the liquids studied. Temp. variation measurements on H_2O show that t temp. dependence of dilatational and shear viscosi in this substance is identical. Introduction of valu for the dilatational viscosity into acoustical calculatio eliminates the well-known discrepancy between theo and observation of sound absorption in liquids very high frequencies.

532.133 : 536.4.0

Viscosity and density in the supercooled liquid sta *See Abstr.* 4726

532.133 : 541.

4515. Viscosity and molecular association. THOMAS, L. H. *J. Chem. Soc.*, 1345–9 (*Sept.*, 1948). Equations previously put forward by the auth [Abstr. 543, 2784 (1947)] are extended to associat liquids. A viscometric method of calculating degre of association of alcohols and amines has be proposed and it is shown that 10 lower alcoh exhibit degrees of association which are essentia independent of temp. throughout the range for whi data are available. W. R.

532.133 : 541.

4516. Viscosity and molecular association. II. relationship between viscosity and vapour pressure associated liquids. THOMAS, L. H. *J. Chem. So* 1349–54 (*Sept.*, 1948).—A general equation is advanc which connects the viscosity of an associated liqu with vapour pressure. Degrees of association f 15 alcohols have been computed as functions of tem and it appears that stable complexes are formed low temps. W. R.

532.1

4517. Simple method and measuring instrument f investigating flow behaviour of highly viscous liqui WILLENBERG, H. AND FRITZ, W. *Angew. Chem* **20 B**, 134–9 (1948) *In German.*—The capillary visc meter is particularly suitable for "non-Newtonia liquids which exhibit structural viscosity, thixotrop etc. It consists of two vertical cylindrical containe connected by a horizontal capillary, and a weight piston sliding in each cylinder for moving the liqu from one cylinder to the other. By varying the lo on the pistons, the liquid is moved to and fro throu the capillary any desired number of times, the veloci of the pistons being $\propto 1/\mu$. The instrument operative at a temp. range of −80° to over 100° a for values of μ of 10^1 to 10^6 poises, with experiment errors of 1–2%. In examples on fats and oils, curv are plotted showing the effect of shearing stress a duration of experiment on μ. A further developme in which the capillary is replaced by a metal diaphrag of variable aperture, and which is operative for valu of μ up to 10^{10} poises, is described. B.

532.1

4518. Measurement of high viscosities at low ter peratures. HENNENHÖFER, J. AND FRITZ, W. *Ange Chem.*, **20 B**, 201–5 (1948) *In German.*—Standa types of viscometers for high-μ measurements a described and their disadvantages noted. The ne viscometer consists of a precision-bore tube (i mersed in a special low-temp. thermostat). The under test is made to rise in the tube under 60 c water pressure (obtained from compressed air) a the time required by the oil to rise between fix

marks is observed. μ is $\propto$ the time taken. The flow velocity decreases along the tube (due to back-pressure of the oil column), and by affixing more than 2 marks and noting the time taken by the oil to rise between them additional information can be gained as to whether it is a normal or abnormal liquid. This makes the calculation of a mean value of μ possible in one single run. The low temp. thermostat used by the former Physikalisch–Technische Reichsanstalt is described. B. A.

532.137

4519. An improved viscometer. Jacobs, H. R. *Rev. Sci. Instrum.*, **19**, 816–17 (*Nov.*, 1948).—The viscometer consists of 2 reservoirs connected by a horizontal capillary tube, the liquid being driven through the capillary under pressure. The rising level of the liquid in the reservoir into which it is forced exerts a hydrostatic pressure which is compensated for in a compensator, such that when the level of liquid rises in the receiving reservoir the pressure in the air driving the liquid out of the discharging reservoir rises in exact measure with it. The air is introduced into the reservoirs at the exact level of the capillary so that the manometer included registers the actual pressure driving the liquid. The flow can be measured in either direction along the capillary. This viscometer eliminates hydrostatic effects, minimizes surface tension effects and "flow lines" can be drawn for a liquid by means of it. A wide range of pressure is possible. W. H.

532.51

4520. Friction in variable density fluid. Abody, L. E. *Publ. Univ. Tech. Sci., Budapest* (*No.* 3) 133–9 (1948) *In English.*

532.51

4521. Some definitions concerning the boundary layer. Brun, E. and Vasseur, M. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 6) 118–20 (1948) *In French.*—The authors attempt to attach precision to the various expressions used for 8 of the thicknesses commonly occurring in discussions of the boundary layer in the case of plane fluid flow, and propose a notation and terminology which eliminates the use of starred symbols. J. S. G. T.

532.51

4522. Thermal study of the laminar boundary layer. Brun, E. and Vasseur, M. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 6) 121–8 (1948) *In French.*—A thermodynamical discussion of the motion and thermal exchanges occurring in the boundary layer in the case of laminar fluid flow is presented for 2 separate cases: (1) when the thermal flux at the boundary is zero, and (2) when the temp. is constant at the boundary and has the same value over the whole cylindrical boundary profile. J. S. G. T.

532.516

4523. The motion of a viscous fluid between two concentric spheres. Charron, V. *Publ. Sci. Min. Air France* (*No.* 208) 18 *pp.* (1947) *In French.* Also *Aircr. Engng*, **20**, 123 (*April*, 1948).—A steel ball mounted at the bottom of a slender shaft was rotated inside a stationary transparent sphere, the space between them being filled with different oils. It was concluded that at very low speeds, or with highly viscous liquids, the measured torque varied only slightly from the calculated value. The streamlines followed the horizontal circumference. When the viscosity was small or the angular velocity great, the measured torque was $\gg$ the calculated torque even to the extent of three times, long before the turbulent range was reached. The streamlines were then no longer circumferential but followed complex trajectories. The author suggests that this phenomenon may be explained by the inertia forces involved. I. A.

532.517.4

4524. A mathematical example displaying features of turbulence. Hopf, E. *Commun. Appl. Math.*, **1**, 303–22 (*Dec.*, 1948).—The example presented is a non-linear space-time system, and is believed to be the first of its kind in that the future behaviour of its solutions can be completely determined. The detailed study of this space-time system reveals geometrical features of the phase flow which come close to the qualitative picture believed to prevail in the hydrodynamic cases. The analogy does not extend to the quantitative relations found to hold in turbulent fluid flow. I. A.

532.517.4 : 533.6.013.22

4525. On the theory of statistical and isotropic turbulence. Heisenberg, W. *Proc. Roy. Soc. A*, **195**, 402–6 (*Dec.* 22, 1948).—Statistical theory of turbulence is applied to discuss the decay of turbulent motion caused, e.g., by a mesh grating in a wind tunnel as studied by Batchelor and Townsend [Abstr. 2369, 3651 (1948), 2786 (1947)]. Contrary to the earlier view that turbulence was caused by viscosity, the author considers that viscosity reduces the number of degrees of freedom of a liquid, and therefore only through viscosity is laminar motion possible. Turbulence is essentially a statistical problem of the same type as occurs in statistical mechanics and the equation for the dissipation of energy owing to turbulence given by Heisenberg is a very simple way of describing the similarity properties of the motion. J. S. G. T.

532.52

4526. Fluid flow through randomly packed columns and fluidized beds. Ergun, S. and Orning, A. A. *Industr. Engng Chem.*, **41**, 1179–84 (*June*, 1949).

532.52

4527. Fluid flow in porous media. Barrer, R. M. *Disc. Faraday Soc.* (*No.* 3) 61–72 (1948).—Transport of a fluid in a porous medium depends on various properties of the fluid and of the medium. Formulae are developed for the displacement of one liquid by another, the flow of gases and the flow of gas and vapour. Applications to the measurement of surface area of powders, molecular and streaming flow are given and the results are shown in tabular form. E. H. D.

532.52

4528. Some physical aspects of water flow in porous media. Carman, P. C. *Disc. Faraday Soc.* (*No.* 3) 72–7 (1948).—The viscous flow of water in porous media is discussed in general but particularly in connection with the limitations of Kozeny's Law, the estimation of pore diameters by permeability and

capillarity measurements, and the determination of particle size and surface area. E. H. D.

532.527

4529. Mechanics of suspensions in the case of a cyclone. BRUN, E. AND VASSEUR, M. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 6) 112–17 (1948) *In French.*—The motion of small particles carried by a stream of fluid flowing along logarithmic-spiral paths in a cyclone with an axial discharge is discussed mathematically, under the condition that the relative velocity of the particle and fluid, and its dimensions, are sufficiently small for Stokes's law to be applicable. It is shown that the trajectory of a particle of sufficiently high density, in any case > that of the fluid, may be a circle which is stable and traversed with uniform speed; an infinite number of other trajectories of identical particles asymptotic to this circle is possible. A preliminary qualitative verification of the theory has been obtained in the case of H_2O, carrying variously coloured insoluble powders in suspension, supplied tangentially to a cylindrical vessel and drawn off through an axial cylindrical tube. The theory enables one to calculate the max. radius of a cyclone designed to extract dust particles of a given size from air. J. S. G. T.

532.542.1

4530. Resistance and inertia of the flow of liquids in a tube or open canal. SCHÖNFELD, J. C. *Appl. Sci. Res.*, **A1** (*No.* 3) 169–97 (1948) *In English.*—The problems considered are so chosen as to illustrate the distinction between slowly varying motions where resistance dominates and quickly varying motions where inertia dominates. They include, under laminar flow problems, that of forced oscillations of a viscous fluid in a round tube and the cognate one-dimensional problem of motion in a crevice. Free oscillations in a round tube in series with a capacitance member are also considered. In each case the hydraulic system is treated as analogous to an electrical system having *L*, *R* and *C*. The theoretical results agree with experimental values obtained by Mcnneret in 1911. Solutions are given which represent motions in open canals and in tubes of elliptic, rectangular, and other cross-sections. In addition solutions are obtained to represent slow motions in parallel layers where turbulence may be considered as fully developed: and the theoretical results are in satisfactory agreement with tidal observations taken in the Helsdeur, one of the estuaries of the Zuiderzee. G. G.

532.583

4531. On the heaving motion of a circular cylinder on the surface of a fluid. URSELL, F. *Quart. J. Mech. Appl. Math.*, **2**, 218–31 (*June*, 1949).—The motion of a fluid of infinite depth which arises when a horizontal cylinder of circular cross-section oscillates with small amplitude about a mean position, in which the axis of the cylinder is assumed to lie in the mean surface, is considered. It is further assumed that the resulting motion is 2-dimensional; this assumption is justified when the cylinder is long compared with a wavelength, or when the fluid is contained between vertical walls at right angles to the axis of the cylinder. Expressions are obtained for the wave motion at a distance from the cylinder, and for the increase in the inertia of the cylinder due to the presence of th fluid.

532.593 : 551.48

The behaviour of waves on tidal streams. *Se Abstr.* 5152

CAPILLARITY 532.6

532.6

4532. Surface tension of a regular solution PRIGOGINE, I. *Trans. Faraday Soc.*, **44**, 626–8 (*Sept* 1948).

532.6

4533. Principles of penetration of liquids into solids ADAM, N. K. *Disc. Faraday Soc.* (*No.* 3) 5–1 (1948).—An introduction to the Discussion. Th following points are touched on: penetrating pressur required to force a liquid into a capillary; penetratio into capillaries of complex shape; hysteresis of th contact angle θ and the various extant explanation of this; effect of roughness on θ; effect of an orderl arrangement, e.g. of textile fibres, in raising th measured θ; modification of surface tension in ver narrow capillaries. S. J. G

532.61.0

4534. Determination of surface tension by the sessil bubble method. WHEELER, O. L., TARTAR, H. V. AN LINGAFELTER, E. C. *J. Amer. Chem. Soc.*, **67**, 2115–1 (*Dec.*, 1945).—An improved apparatus for th determination of surface tension by the sessile bubbl method has been devised in which the dimensions o the bubble are measured by a comparator. Certai deviations from the proper values are due to bubbl shape and have been determined for a wide range o shapes. Derived empirical equations permit deter mination of surface tension by this method with goo precision. A photographic method has also bee devised and its use has revealed that the anomalie encountered with the comparator are due to inaccurat definition of the equatorial plane by the horizonta slit of light transmitted by the bubbles. W. R. A

532.611

4535. Surface tension of [molten] metals. BREGER A. KH. AND ZHUKHOVITSKY, A. A. *J. Phys. Chem USSR*, **20**, 355–62 (1946) *In English.*—A mathematica treatment of the Sommerfeld model of the metalli state leads to the conclusion that total surface energ should rise with increasing comminution of a give vol. of metal. The expression $\sigma = (\rho/A)^{4/3}$ give values in accordance with experimental data for number of metals of at. wt. *A*, and follows fron considerations of density of the electron cloud at th surface, and of mol. electronic orbits. B. A

532.612 : 548.

4536. Relationship between surface tension an crystalline habit. II. MILONE, M. AND FERRERO, F *Gazz. Chim. Ital.*, **77**, 348–52 (1947) *In Italian.*— Addition of up to 10% of urea to a 30% aq. solutio of NaCl reduces the surface tension (γ) progressivel from 74·5 to 56 dynes per cm, and evaporation of th last-named solution produces octahedral NaCl crystals Other substances, e.g. sugar molasses, hydrolyse

gelatin, Leonil–S (the Na sulphonate derivative of a naphthalene homologue), or methylene-blue, in small quantities, produce similar reductions in the γ of NaCl solutions. The results show that when γ is $\geq$ 50 dynes per cm, crystallization occurs in octahedra or in a mixed cubo-octahedron form. Analogous results were obtained with KCl, NaI and NaBr. B. A.

532.62

4537. Ionic forces in thick films of liquid between charged surfaces. SCHOFIELD, R. K. *Trans. Faraday Soc.*, **42 B**, 219–28 (1946).—A formula for calculating the thickness θ of the film adhering to a solid surface is derived, assuming that the ions in the film forming the diffuse component of the electrical double layer are all of one kind, with charge opposite to that on the surface; the valency of the ions, the surface density of charges on the surface and the dielectric constant are involved. θ thus calculated is in good agreement with the optical measurements of Deryagin and Kussakov for films of water on mica and glass, of hexanol on glass and of hexane on steel, but not of NaCl solution on glass. S. J. G.

532.696

4538. Characteristics of fluid-solid systems. MATHESON, G. L., HERBST, W. A. AND HOLT, P. H. *Industr. Engng Chem.*, **41**, 1099–104 (*June*, 1949).—The effects of particle size and particle density on the maximum bed density and Stormer viscosity of the dense phase of fluid-solid systems have been investigated. Correlations have been developed quantitatively relating the increase in the maximum bed density of irregular particles with increasing particle size or particle density. The Stormer viscosity of the bed is shown to be related to the flow behaviour of such systems. The viscosity of a fluidized narrow cut solid increases with increasing particle size and density. Fines have a marked influence on the viscosity of solids of wide particle size range, particularly in concentrations up to 30%. A.

532.696

4539. Mass and momentum transfer in solid-liquid system. Fixed and fluidized beds. MCCUNE, L. K. AND WILHELM, R. H. *Industr. Engng Chem.*, **41**, 1124–34 (*June*, 1949).—Deals with mass transfer between an upward stream of liquid and solid particles in consolidated and in expanded, fluidized beds. The solid particles in question were 2-naphthol and the liquid was water. It is believed that the mass transfer results are applicable equally well to heat transfer under similar physical circumstances. A.

MOLECULAR THEORY OF LIQUIDS 532.7

532.712

4540. Osmotic diffusion pump. FRANCK, J. AND MAYER, J. E. *Arch. Biochem.*, **14**, 297–313 (1947).—A pump which can use chemical energy to transport materials (either solvent or solute) from one solution to another in the direction opposite to the natural diffusion tendency is described. Cross-current diffusion of the reactant and products of a chemical reaction, formed catalytically at one membrane wall and reversed in excess of equilibrium at the other wall, is utilized. B. A.

532.72

4541. Liesegang interferences and distribution of individual reactants. VEIL, S. *C.R. Acad. Sci., Paris*, **226**, 1603–5 (*May* 19, 1948) *In French.*—Following earlier observations [*ibid.*, **191**, 282 (1931); **224**, 1771 (1947)] on the interdiffusion of solutions of silver nitrate and potassium dichromate, this note provides additional measurements of annular distributions. A. C. C.

532.72

4542. On the role of velocity of the system in diffusion. PRIGOGINE, I. *Bull. Acad. Roy. Belge Cl. Sci.*, **34** (*No.* 12) 930–42 (1948) *In French.*—Depending upon the velocity of the system employed (velocity of mass centre, mean molecular velocity . . .) it is necessary to introduce different coeffs. of diffusion. Making use of the property that for a system in mechanical equilibrium the production of entropy in diffusion is independent of the velocity used, the author establishes the relations which exist between these different coeffs. F. E. H.

532.72

4543. Temperature gradients and eddy diffusivities in turbulent fluid flow. MCCARTER, R. J., STUTZMAN, L. F. AND KOCH, H. A., JR. *Industr. Engng Chem.*, **41**, 1290–5 (*June*, 1949).—An outline of turbulent flow theory is presented and its relation to problems of diffusivity discussed. Elementary equations for the process of diffusion are derived and applied in the correlation of data. The equipment and experimental procedure are described for 2 methods of determining the dimensional value of eddy diffusivity in turbulent gas flow by studies of thermal energy transfer. Experiments were conducted in a vertical 8 in dia. steel duct with flow velocities ranging from 2 to 7 ft/sec. Preliminary results obtained indicate ranges of diffusivity for certain conditions of turbulence from which qualitative deductions may be made regarding the factors influencing diffusion and mixing. A.

532.72 : 533.15

4544. Kinetic theory of diffusion in gases and liquids. I. Diffusion and the Brownian motion. YANG, L. M. *Proc. Roy. Soc. A*, **198**, 94–116 (*July* 22, 1949).—The coefficients of self-diffusion, ordinary diffusion and thermal diffusion are expressed in terms of the first and second moments of certain transition probabilities familiar in the theory of the Brownian motion. It is then found possible in gases of low or moderate density where a fairly well defined free path exists to follow the future course of a given molecule statistically to as many free flights as required provided the velocity distribution of the molecules in the medium is known. This consideration on the one hand leads to a rigorous expression for the coefficient of self-diffusion directly calculated from a Maxwellian distribution, and on the other serves to clarify the relation between the old free-path theory of gaseous diffusion and the rigorous theory of gaseous diffusion and between self-diffusion and mutual diffusion. Further, an approximate theory of diffusion in

liquids corresponding to the old free-path theory in gases is suggested. A.

532.72 : 541.133.1

4545. Particle migration in liquids. WIRTZ, K. *Z. Naturforsch.* **3a**, 672–90 (*Dec.*, 1948) *In German.*—An extensive review with applications to diffusion, viscosity, ionic mobility, thermodiffusion, etc., with a bibliography comprising over 100 entries. H. MO.

532.73–2

4546. Mutual solubility of liquids. VAN ARKEL, A. E. *Trans. Faraday Soc.*, **42 B**, 81–4 (*March*, 1946).—Mutual solubility of liquids depends essentially on the magnitudes of the cohesional energy arising from London–van der Waals forces and of dipole-dipole interaction; but a small, though usually negligible, contribution comes from the dipole-induction (Debye) effect. Methods of evaluating the separate contributions are discussed. W. R. A.

532.782

4547. Some peculiarities of the initial stages of the disintegration of the Fe–N solid solution. ELISTRATOV, A. M. *J. Tech. Phys., USSR*, **18**, 1173–8 (*Sept.*, 1948) *In Russian.*

MECHANICS OF GASES 533

533.21

4548. Compressibility of gases at high temperatures. I. Methods of measurement and apparatus. SCHNEIDER, W. G. *Canad. J. Res. B*, **27**, 339–52 (*April*, 1949).—Methods and apparatus used for compressibility measurements of gases in the range 0°–600°C are described. A further method which can be used at temps. > 600°C is also described. Data for some measurements with pure He at 0° and at 600°C are given, from which the values (in Amagat units), $0{\cdot}527\times10^{-3}$ per atm. $\pm\ 0{\cdot}003\times10^{-3}$ and $0{\cdot}439\times10^{-3}$ per atm. $\pm\ 0{\cdot}005\times10^{-3}$ were obtained for the second virial coefficient at 0° and 600°C respectively. A.

533.21

4549. On the question of density and elasticity measurement of vapours of liquids. SHAKHPARONOV, M. I. *J. Tech. Phys., USSR*, **18**, 1255–7 (*Oct.*, 1948) *In Russian.*—The difficulties besetting the known methods of determination of density and elasticity of vapours are connected with the degree of volatility of the liquid, its state and the temp. conditions. The author proposes a new method claimed to be free of most of these inconveniences. B. F. K.

533.21 : 536.411

4550. The influence of velocity in adiabatic compression. JOHANSSON, C. H. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 37) 14 *pp.* (1948) *In English.*—The adiabatic equation for a perfect gas leads to erroneous results in rapid compression, as in detonation, and here the Hugoniot adiabatic must be used. This is due to the formation of a discontinuous wavefront that has an important influence. The problem is investigated mathematically and the range of validity of the 2 forms of adiabatic relationship examined. It is concluded that the usual equation may be used without notic able error in all applications to the compression of gas in a cylinder, provided the piston velocity is sma compared with that of sound, but even in applicatio where wavefront velocities lower than those e countered in detonation are involved serious err may be caused. F. E.

533.21 : 536.

Compressibility of gas as a function of temperatu *See Abstr.* 4745

533.5 : 531.7 : 536

Vacuum instruments in the Physical Society Exhibition. *See Abstr.* 4732

533.5 : 531.788.

4551. The errors of reading of the Macleod gaug ROMANN, P. *Vide*, **3**, 522–30 (*Nov.*, 1948) *In French.* A theoretical paper giving a mathematical discussi of the errors. L. G.

533.

4552. Study and realization of a new molecul rotary pump. GONDET, M. H. *Vide*, **3**, 513–21 (*No* 1948) *In French.*—Describes a type of molecul pump first put forward by Holweck in 1922, a recently improved. The present pump has a rotati disc, instead of a rotating cylinder. Design calcul tions and measurements of attained speeds a given. L. G.

533.6.0

4553. Flow patterns and the method of chara teristics near a sonic line. HOLT, M. *Quart. Mech. Appl. Math.*, **2**, 246–56 (*June*, 1949).—The wo described has two aims: (i) to investigate the geomet of the flow pattern near a sonic line, and (ii) to devel a method for the numerical integration of the equatio of motion near a sonic line, where the usual meth based on characteristics breaks down. Only ise tropic irrotational steady flow with two independe variables is considered, and attention is mai confined to plane flow.

533.6.0

4554. On a family of rotational spatial gas flo PRIM, R. AND NEMÉNYI, P. *Quart. J. Mech. Ap Math.*, **2**, 129–35 (*June*, 1949).—An investigation made of steady flows of an ideal gas in the absence body forces for which the 3 velocity components a cylindrical co-ordinate system based on a pla isometric net depend on only 1 isometric co-ordina It is shown that such flows exist only if the ba isometric net consists of logarithmic spirals or th limiting cases (concentric circles, radial straight lin and parallel straight lines). Several large classes rotational and spatial gas-flow solutions are obtain some in explicit forms involving an arbitrary fu tion, and others as solutions to ordinary different equations involving several arbitrary parameters.

533.6.0

4555. Problems and progress in low-pressu research. KANE, E. D. AND FOLSOM, R. G. *J. Ae Sci.*, **16**, 46–54 (*Jan.*, 1949).—The nature of t theoretical and experimental problems associated wi the field of rarefied gas dynamics is discussed. T techniques used and under development for pressu measurement and flow visualization are described.

533.6.011.3

4556. The analogue of Blasius' formula in subsonic compressible flow. THIRUVENKATACHAR, V. R. *Proc. Nat. Inst. Sci. India*, **14** (*No.* 8) 339–42 (*Sept.–Oct.*, 1948).—Theoretical. The derivation of the formula is based on the hodograph method developed by Lin. By its application, the Prandtl–Glauert formula for the lift on an aerofoil is obtained. A. S.

533.6.011.3

4557. The Jansen–Rayleigh approximation for the calculation of subsonic flows. WENDT, H. *S.B. Heidelberger Akad. Wiss. (Math.-Naturwiss. Kl.)* (*No.* 7) 147–70 (1948) *In German.*—Theoretical. A detailed derivation of the first and second approximations is given, based on the introduction of a complex potential in which stream-potential and stream-function are combined. The method is illustrated by its application to calculation of plane subsonic flow around a circle between parallel walls. Earlier work along similar lines is mentioned, but no references are given. A. SCH.

533.6.011.4

4558. Applications of the theory of free molecule flow to aeronautics. ASHLEY, H. *J. Aero. Sci.*, **16**, 95–104 (*Feb.*, 1949).—An analysis is made of the forces experienced by a body flying in an extremely rarefied atmosphere such as is to be found from about 120 to 220 km above the earth's surface. At these altitudes the atmosphere can be considered to be composed of free molecules, and the principles of kinetic theory of gases can be used. The Maxwellian distribution is assumed for the thermal velocities, and the opposite extremes of specular, or elastic, reflection and diffuse reflections are considered for the re-emission of molecules from the surface of the body. A table of two different standard atmospheres is computed, using NACA methods. These atmospheres consist of atomic O and molecular N for the one, and atomic O and N for the other. Lift and drag coefficients are computed for certain simple bodies (such as a sphere, a flat plate and a right circular cylinder) and plotted against free-stream Mach number. In addition, techniques are developed for finding analytically or numerically the forces on any object in free molecular flow. A. M. R.

533.6.011.4 : 536.24

4559. Heat transfer to bodies travelling at high speed in the upper atmosphere. STALDER, J. R. AND JUKOFF, D. *J. Aero. Sci.*, **15**, 381–91 (*July*, 1948).—The authors calculate equilibrium temps. for flat plates moving at speeds from 0 to 20 000 f/s, attack angles from 0 to 20 deg., altitudes from 75 to 150 miles, with or without solar radiation and internal heat transfer. For the altitudes considered, the molecular mean free path in the atmosphere is so large that customary aerodynamics is invalid, and the authors' results can be generalized to arbitrarily shaped bodies by simple integration. The principal conclusions are: (1) With solar radiation absent, the skin-cooling problem is negligible for altitudes $\geqslant 100$ miles, speeds $\leqslant 20\,000$ f/s, and attack angles $\geqslant 20$ deg. (2) The effect of solar radiation on skin temperature is small at 75 miles altitude—predominant at 150 miles. (3) High fineness ratio and much surface at negative attack angles lessen heating effect. A. M. R.

533.6.011.5

4560. Unsteady one-dimensional flows with heat addition or entropy gradients. KAHANE, A. AND LEES, L. *J. Aero. Sci.*, **15**, 665–70 (*Nov.*, 1948).—Non-linear differential equations of the Riemann type are derived for the solution of problems involving the propagation of one-dimensional waves in flows in tubes of slowly varying cross-sectional area with heat addition or entropy gradients. These equations can be solved graphically or numerically by the method of characteristics described. I. A.

533.6.013.21

4561. Eddy diffusion and evaporation in flow over aerodynamically smooth and rough surfaces: a treatment based on laboratory laws of turbulent flow with special reference to conditions in the lower atmosphere. CALDER, K. L. *Quart. J. Mech. Appl. Math.*, **2**, 153–76 (*June*, 1949).—A theoretical treatment of the problems of eddy diffusion and evaporation is developed, based on the use of well-established laboratory data for the laws of turbulent flow. Expressions which are free from adjustable constants and involve only directly measurable quantities are derived for the 2-dimensional diffusion of matter and evaporation of liquid in flow over aerodynamically smooth and rough surfaces. For aerodynamically smooth surfaces the evaporation formulae obtained are identical with those found previously by Sutton [Abstr. 4480 (1934)], using a different treatment. The latter results, which have been shown to be in good agreement with laboratory experiments, may be derived independently as a special case by a more direct method involving fewer assumptions. The formulae obtained for aerodynamically rough surfaces are in excellent agreement with observational data on the diffusion of smoke in the lower atmosphere under adiabatic conditions, and on the evaporation of liquid from the ground surface. The treatment may also be applied to the transfer of heat from aerodynamically smooth and rough surfaces provided the temp. differences are not too large. A.

533.6.013.22

4562. Progress in the statistical theory of turbulence. VON KÁRMÁN, T. *Proc. Nat. Acad. Sci., Wash.*, **34**, 530–9 (*Nov.* 15, 1948).—After a short summary of previous investigations, the theory of turbulence is formulated so as to show clearly the dependence of each result on particular assumptions, and to indicate where further investigation is required. G. G.

533.6.013.22

4563. Note on the law of decay of isotropic turbulence. LIN, C. C. *Proc. Nat. Acad. Sci., Wash.*, **34**, 540–3 (*Nov.* 15, 1948).—Kolmogoroff has shown that the double and triple correlation functions are expressible in terms of functions of a certain type. By introducing the assumption of self-preservation with reference to these functions, a definite law of decay is arrived at, different from all previous ones, and in agreement with available experimental data. G. G.

533.6.013.22 : 532.517.4

On the theory of statistical and isotropic turbulence. *See Abstr.* 4525

533.6.07

4564. Flow characteristics of solids-gas mixtures in a horizontal and vertical circular conduit. FARBAR, L. *Industr. Engng Chem.*, **41**, 1184–91 (*June*, 1949).

MOLECULAR THEORY OF GASES 533.7

533.7

4565. Remark on the dynamics of gaseous mixtures with diffusion. PRIGOGINE, I. *Bull. Acad. Roy. Belge, Cl. Sci.*, **34** (*No.* 10) 789–94 (1948) *In French.*—Pressure tensors p^{ij}, P^{ij} are defined in terms of velocities measured with respect to the mean motion (i) of each constituent, (ii) of the whole mixture. In a first approximation P^{ij} reduces to ordinary pressure, but p^{ij} involves diffusion explicitly. This result is used to criticize Verschaffelt's work [see following Abstr.]. R. A. N.

533.7

4566. On the dynamics of non-homogeneous gaseous mixtures. VERSCHAFFELT, J. E. *Bull. Acad. Roy. Belge., Cl. Sci.*, **35**, 31–41 (*Jan.*, 1949) *In French.*—Previous work [Abstr. 1720 (1949)] is defended against Prigogine's criticisms [preceding Abstr.] by showing that formulae derived for ideal fluids are consistent with Chapman and Cowling's equations for diffusion. An earlier restriction to the case of no molecular encounters is now found to be unnecessary. R. A. N.

533.7 : 532.522

4567. The influence of the mean free path of the molecule of a gas on its flow through an orifice at the speed of sound. AGOSTINI, L. *Publ. Sci. Min. Air France* (*No.* 214) 74 *pp.* (1948) *In French.*—Experiments were made with air and H traversing convergent and divergent orifices of small minimum diameter (47 μ or less). The flow calculated from molecular theory does not agree with that actually found. For example, the flow is not independent of pressure below the orifice. I. A.

533.75 : 536.71 : 541.126

4568. An equation of state for gases at extremely high temperatures and pressures from the hydrodynamic theory of detonation. PATERSON, S. Letter in *J. Chem. Phys.*, **16**, 847 (*Aug.*, 1948).—Commenting on Cook's reply [Abstr. 3167 (1948)] the author persists in his criticisms [Abstr. 1176 (1948)] of Cook's method of solution and claim that a general solution is, in principle, possible. A. SCH.

VIBRATIONS . ACOUSTICS 534

534.014.5

4569. Forced oscillations of a particular non-linear system. MANACORDA, T. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **4**, 557–61 (*May*, 1948) *In Italian.*—A mass point is connected to 2 fixed points *A*, *B* by 2 elastic strings and is free to move on the axis of the segment *AB*. The point als undergoes forced oscillations along this axis. Th equation of motion is non-linear. It is proved tha it has periodic solutions, at least when certain con ditions are satisfied. L. I

534.

4570. A trigonometric relation and group-velocity BAIADA, E. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sc. Fis. Mat. Nat.*) **5**, 355–62 (*Dec.*, 1948) *In Italian.*— Group velocity is generally defined as $v_g = df/dk$ (f = frequency, k = wave-number). It is shown tha a better definition is $v_g = \int_{-\infty}^{+\infty} A^2(k)(df/dk)dk$, where $A^2(k)$ is the normalized spectral distribution of th group of waves. L. I

534.

4571. Non linear vibrations. CARTWRIGHT, M. L. COPSON, E. T. AND GREIG, V. *Adv. of Sci., VI*, 21 64–75 (*April*, 1949).—The general methods fo solving the differential equation of a non-linea vibration problem are reviewed. These includ step-by-step numerical methods, classical methods o approximation, topological methods, and approxi mations with large non-linear terms. Other topic discussed are relaxation oscillations, numerical an graphical solutions and recent work by Shohat Siegel, Müller–Strobel, etc. An extensive and up-to date bibliography is given. L. S. G

534.

4572. Construction for non-linear sinusoidal oscil lators by the moving axis method. ABELÉ, J. *Ann Phys., Paris* (*Ser.* 12) **3**, 655–79 (*Nov.–Dec.*, 1948) *I French.*—The author defines the amplitude of an oscillator obeying a differential equation of the second or higher order, in the case where this ampli tude varies as a function of time, by the locus o maxima which makes it a continuous function o time. He then applies this definition to a linea oscillator, gives it a kinematic representation by a rotating vector and deduces from this representation a construction process for the linear oscillator. Finally he shows that this definition and construction process can be extended, by means of a generalization of the original hypothesis, to a class of non-linear oscillators whose stable states are strictly sinusoidal. Controlled-amplitude oscillators belong to this class and the author indicates one of the techniques enabling the general equations to be applied to them. S. C. D.

534.211

4573. Vibration modes of straight bars with thin-walled unclosed sections. FEDERHOFER, K. *S.B. Öst. Akad. Wiss., Abt.* **IIa** (*Nos* 7–8) 393–416 (1948) *In German.*—Bending of bars of unsymmetrical section under the action of transverse forces is accompanied by twisting of the bar. A general theory of the flexural vibrations of bars which includes the effect of the torsional vibration is developed. The solution involves a differential equation of the twelfth order. The special case of a channel section bar is discussed in detail and tables and curves are given for the numerical determination of the vibration frequencies. T. S. E. T.

534.211 : 539.32.08

4574. Transmission of elastic pulses in metal rods. Hughes, D. S., Pondrom, W. L. and Mims, R. L. *Phys. Rev.*, **75**, 1552–5 (*May* 15, 1949).—Pulses are generated at one end of a cylindrical rod by a quartz crystal. A second crystal at the opposite end is used as a detector. The transmission time is studied as a function of rod length, diameter, and material. In general a single input pulse gives rise to several pulses at the detector. For the dimensions and rise times used, all of the arrivals are explicable in terms of transmission with either the dilatational or rotational velocity of the material or a combination of both. These velocities can be computed from the data and hence the elastic constants of the material. A.

534.221 : 532.133

The second viscosity of liquids. *See Abstr.* 4514

534.23

4575. Absorption measurements of sound in sea water. Thiessen, G. J., Leslie, J. R. and Simpson, F. W. *Canad. J. Res. A*, **26**, 306–12 (*Sept.*, 1948).—Sound absorption measurements made with a diverging beam in sea water are described. They cover a frequency range 0·35 to 2·3 Mc/s, the measurements being made in Vancouver Harbour over a distance 3 to 30 m in a depth of 4 to 6 m (depending on tide). The experimental results are tabulated and show a steady increase from 0·080 db/m at 0·355 Mc/s to 1·61 db/m at 2·30 Mc/s. A. B. W.

534.23

4576. Sound absorption by porous materials II. Kosten, C. W. *Appl. Sci. Res.*, **B1** (*No.* 4) 241–50 (1949) *In English.*—In analogy with Kirchhoff's correction to the velocity of sound in wide tubes the correction in the case of narrow tubes is considered, in which the flow is essentially of the Poiseuille type. The correction is of minor influence upon the damping and sound velocity, but may be of great importance for the absorption coefficient of absorbing porous materials. Instead of the normal thermal conductivity an apparent conductivity has to be introduced which can be a few times < the normal one. A striking consequence is that absorbing layers of reasonable porosity should show a minimum absorption even in extreme circumstances. A.

534.23 : 550.34

4577. Raleigh waves in an indefinite, elastic, firmo-viscous medium. Caloi, P. *Acta Pont. Acad. Sci.*, **10** (*No.* 14) 143–54 (1946) *In Italian.*—There is a difference between the observed value of the ratio of horizontal and vertical components of surface waves and the value calculated on Rayleigh's theory. The theory is modified by introducing the idea of firmo-viscosity and the discrepancy reduced. W. A. R.

534.232 : 534.321.9 : 621.395.625

4578. An electroacoustical system. Walker, E. A. *Trans. Amer. Inst. Elect. Engrs*, **67**, 35–41 (1948).—Describes an equipment which generates a supersonic signal used specifically to locate lost torpedoes, but has many applications. Other means are mentioned which were tried unsuccessfully. The supersonic signal was generated in the torpedo itself at the end of its run. Choice of freq. is governed by the fact that the attenuation of sound in water approx. doubles every octave; at the same time, to achieve a given directivity the dia. of the receiving hydrophone must be doubled as the freq. is halved. Two types of projectors, with their polar diagrams, are described. The receiver utilizes a hydrophone with a rotatable acoustic baffle $\lambda/2$ behind the vibrating element (25 kc/s corresponds to $\lambda = 2{\cdot}5$ in. in H_2O) to enable it to search in depth. The hydrophone and receiver are illustrated together with a circuit of the latter. B. B. A. (R)

534.232 : 534.414

4579. On the radiation of sound into a circular tube, with an application to resonators. Ingard, U. *Acta Polytech.*, **23** [*Elect. Engng, Ser.* 1 (*No.* 8)] *Trans. Chalmers Univ. Tech., Gothenburg*, **70**, 5–48 (1948) *In English.*—The case of a plane piston source and rigid tube is treated theoretically, with reference to the propagation of higher order sound waves. The equivalent impedance circuits are given together with curves of radiation impedance and pressure distribution, for the case of the infinite tube and the tube terminated by a rigid wall or impedance. Measurements made of pressure distribution and impedance for the case of the tube terminated by a rigid wall, verify the theoretical results. The resonant frequency of resonators is also calculated and agreement with measured values obtained. G. F. H.

534.232 : 621.395.613

4580. Single-element unidirectional microphone. Olson, H. F. and Preston, J. *J. Soc. Mot. Pict. Engrs*, **52**, 293–302 (*March*, 1949).—A single-element unidirectional microphone for use in sound motion picture recording has been developed with the following characteristics: single-ribbon type; the back of the ribbon is coupled to a damped folded pipe and an acoustical impedance in the form of an aperture; improved cardioid directional pattern; greater output; reduced weight; and reduced wind-noise response. A.

534.23

4581. Absorption by sound-absorbent spheres. Cook, R. K. and Chrzanowski, P. *J. Acoust. Soc. Amer.*, **21**, 167–70 (*May*, 1949).—The calculations are based on the assumption that the complex ratio of sound pressure at a point on the sphere's surface to the normal component of particle velocity is a constant independent of the direction of incidence ("normal impedance assumption"). Absorption measurements were made on hair felt-covered spheres placed in a reverberation room, and were compared with the computed absorption by means of the reverberation room statistics appropriate for spheres. The theory and measurements both show that absorbent spheres can have absorption coefficients > unity. The discrepancies between theoretical and experimental coefficients seem to indicate that the normal impedance assumption is not valid for the hair felt used in the experiments. A.

534.321.9

4582. The production of high intensity ultrasonics at megacycle frequencies. Selman, G. G. and Wilkins, M. H. F. *J. Sci. Instrum. Phys. Ind.*, **26**, 229–31 (*July*, 1949).—A piezo-electric apparatus is described. The use of transmission plates and various focusing

devices have been investigated and beams of high intensity unfocused ultrasonics have been generated and measured by a calorimetric method up to a max. intensity of 55 W/cm². The factor limiting the power output was shown to be the dielectric strength of the transformer oil used. The apparatus was developed for the irradiation of biological material with a uniform intensity of ultrasonics over an area of a few cm². A.

534.321.9 : 539.3

4583. Mechanical properties of solids. IV. Wave propagation in solids, ultrasonics. HIEDEMANN, E. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 154–78 (1947) *In German.*—Many experimental results are recorded for the propagation of sound and supersonic waves in solids of many types, and for specimens of varying shapes and sizes. The use of a supersonic lens is described and photographs of sound waves in certain materials are given. The principles are applied in flaw detection by supersonic waves. C. A. H.

534.321.9 : 548.0

Ultrasonic measurements on Rochelle salt crystals. *See Abstr.* 5093

534.321.9 : 621.389

4584. Electronic circuits of a supersonic reflectoscope. DELANO, R. B., JR. *Trans. Amer. Inst. Elect. Engrs*, **67**, *Pt I*, 128–37 (1948).—Describes a supersonic device for the non-destructive testing and measuring of solid parts, such as defects in castings and welded parts. A feature is the operation from raw a.c. owing to the use of a short-duty cycle. Supersonic pulses are provided by an X-cut quartz plate $\lambda/2$ thick excited by a 1 000 V pulse. The reflected pulse is amplified by an amplifier of 9–12 Mc/s bandwidth, and this together with time marks are applied to the horizontal trace of the c.r.t. used for viewing. These time marks consist of square waves supplied by an adjustable pulse generator. The distance of a fault from the surface is obtained by counting the number of square wave cycles appearing between the initial pulse and the defect reflection. A photo of the trace showing a typical fault is given, together with the circuit and description of its operation. B. B. A. (R)

534.612

4585. The accuracy of measurements by Rayleigh disc. WEST, W. *Proc. Phys. Soc., Lond. B*, **62**, 437–44 (*July*, 1949).—A review of proposals made for altering the formula due to König, on which are based measurements of air-particle velocity by Rayleigh disc, leads to the conclusion that there is insufficient evidence for altering the numerical constant in the formula. Comparisons between Rayleigh disc and other methods of calibration of individual microphones are discussed, and the possibility of difference due to reaction on the sound pressure by the vibration of the diaphragm is considered. A.

534.647 : 550.341

4586. Triggered telerecording seismic equipment. GANE, P. G., LOGIE, H. J. AND STEPHEN, J. H. *Bull. Seism. Soc. Amer.*, **39**, 117–43 (*April*, 1949).—Electronic equipment is described which has been designed for research into the Witwatersrand earth tremors. It enables 6 seismograms (originating at different sites up to 17 km away) to be recorded side by side on a common time scale. High-speed recording is obtained by automatically triggering the (usually stationary) recorder, while the signals are "stored" for 6 seconds on a magnetic tape delay unit so that no part of the record is missed. Automatic magnification control is used at the transmitting end, and a method of frequency-modulating a sub-carrier, appropriate for transmitting very low-frequency signals, is described. Some seismograms obtained by this means are shown. A.

534.85 : 621.396.622 : 621.315.61 : 537.228.

Synthetic piezoelectric material. *See Abstr.* 4771

534.851 : 621.395.62

4587. Ceramic phonograph pickup. HECTOR, L. G. AND KOREN, H. W. *Electronics*, **21**, 94–6 (*Dec.*, 1948).—Barium titanate, as discussed in Abstr. 4771 (1949), is used. The pick-up gives a nominal output of 0·75 V at 1 kc/s when working into a 1 MΩ load with a tracking weight of 22 g with normal records, the corresponding figures for micro-groove records at 33⅓ r.p.m. being 0·25 V and 6 g. The two ceramic strips are soldered to a metal armature which is clamped at one end and soldered to a sapphire needle-arm at the other, thus providing a compliance step-down from needle point to elements. Design procedure for good h.f. response and the method of measuring effective mass are described. Manufacture and testing are discussed in some detail. H. G. M. S. (R)

534.851 : 621.395.62

4588. Design of L-P records. *Electronics*, **21**, 110–11 (*Dec.*, 1948).—Basic design factors of long-playing records are: (1) the need for 20 min playing time on one side of a 12 in record; (2) the existence of an optimum ratio of 2/1 for outside dia./inside dia.; (3) the selection, from past experience, of 33⅓ r.p.m. for the speed; and (4) the desirability of a frequency range of 30 c/s to 10 kc/s. This results in a figure of 224 for the number of grooves/in. The relative performances of 78 r.p.m., transcription and L.P. records are discussed, having regard for needle point radius, groove deviation, limiting frequency and harmonic content. The use of vinylite for the base and of lightweight pick-ups, giving an output of 0·5 V r.m.s., makes possible a dynamic range of 45 db with an acceptable noise level. H. G. M. S. (R)

534.86 : 621.395.623.7 : 621.396.62

4589. Electroacoustics of broadcast receivers. GOVYADINOV, V. A. *Radiotekhnika*, **3** (*No.* 6) 88–95 (1948) *In Russian.*—The idea of the critical damping resistance is introduced, which is a function of the speaker gap flux, moving mass and resonance frequency of the speaker system, including the moving air column, conductor length contained in the speech coil and its ohmic resistance. It is shown that for good reproduction, avoiding bass booming and resonance effects, this critical resistance must be at least 1·4 to 2·7 × the speech coil resistance. A. L. (R)

534.862 : 621.395.625

4590. A demonstration studio for sound recording and reproduction and for sound film projection. *Philips Tech. Rev.*, **10**, 196–204 (*Jan.*, 1949).—The studio is equipped for demonstrations of various types

of programme sources, amplifiers, loudspeakers and film projection equipment, as well as for sound recording by different systems. The acoustic properties are such that the reverberation time at the higher frequencies (0·9 sec at 2 000 c/s) is only slightly less than at the lower frequencies (1·3 sec at 100 c/s), this having a very beneficial effect on the high note response. An elaborate relay system permits of any combination of a sound source (microphone, "Philimil" tape, magnetic tape, or radio receiver), an amplifier, and one or more loudspeakers. From the control desk one or several programmes can be passed to different recording equipment, viz. the Philips–Miller, the magnetic or the photographic equipment, or the gramophone recording unit. Arranged round the studio itself are a microphone room, "speech studio," projection, control and recording rooms. A.

534.862.4 : 621.395.623.7

4591. New theater loudspeaker system. HOPKINS, H. F. AND KEITH, C. R. *J. Soc. Mot. Pict. Engrs*, **51,** 385–98 (*Oct.*, 1948).—The new system employs sectoral high-frequency horns and a crossover frequency of 800 c/s. Improvement is obtained in uniformity of distribution and reduction of size and weight. A.

534.88 : 527

4592. Sonic navigation system. RICH, S. R. AND ROSEN, A. H. *Electronics*, **21,** 92–7 (*Nov.*, 1948).—For use in narrow channels and the like, repetitive signals emitted by pairs of underwater sound transducers are received by hydrophones and reproduced in a loudspeaker. One of the pair of signals can be distinguished from the other by frequency difference and successive pairs by coding. For any one pair, signals can be emitted simultaneously or with a fixed time interval, and can be designed to reach the channel centre similarly, depending upon the shape of the channel and the existence of one or two lanes. For transmission a simple motor-driven commutator effects keying and coding. For reception, if desired, one hydrophone or sea tube can be employed with 2 filters and amplifiers and one loudspeaker. A more elaborate meter-indicating system is also described. Position determination within 50 yd is possible. H. G. M. S.

OPTICS . RADIATION . SPECTRA 535

535.23.08 : 518.5

4593. Simplified calculation of black-body radiation. CANADA, A. H. *Gen. Elect. Rev.*, **51,** 50–4 (*Dec.*, 1948).—A slide rule for the calculation or conversion of radiant energy relationships based on the Planck, Stefan–Boltzmann, and Wien radiation laws, is described. Conversion scales for wavelength to wave number, and between different energy, and temp., units are incorporated. S. W.

535.23.08 : 536.33.08

4594. A new classification system for radiation detectors. JONES, R. C. *J. Opt. Soc. Amer.*, **39,** 327–43 (*May*, 1949).—A classification system is proposed, based upon the manner in which the noise equivalent power depends upon the time constant and the sensitive area, when the sensitivity is limited either by radiation fluctuations or by internally generated noise. The detectors studied include bolometers, thermocouples and thermopiles, the Golay detector, photographic plates and films, vacuum and gas photo-tubes and photo-multiplier tubes and dipole aerials. In the case of the latter it is shown that Johnson noise becomes equivalent to the noise produced by radiation fluctuations. A.

535.23.08 : 536.33.08

4595. Factors of merit for radiation detectors. JONES, R. C. *J. Opt. Soc. Amer.*, **39,** 344–56 (*May*, 1949).—The need for a suitably defined factor of merit for comparing the sensitivity of different radiation detectors is explained. Both the advantages and the very important limitations of such a factor of merit are discussed. A.

535.241.3

4596. The new candle. DE GROOT, W. *Philips Tech. Rev.*, **10,** 150–3 (*Nov.*, 1948).—A translation of the resolutions approved by the Comité Int. des Poids et Mesures, with regard to the new unit of light introduced on Jan. 1, 1948. Since the luminance (brightness) of a cavity radiator at the point of solidification of Pt is, by definition, 60 new candles/cm² it is possible to calculate the mechanical equivalent of light, given the temp. of the Pt point and the value of Planck's radiation constant c_2, and using the international luminosity function. For $c_2 = 14\,385$ μ-degrees and 2 041·7°K the value found is 683 new lumens/watt. The brightness of the cavity radiator at other temps., based on the same values, is tabulated. J. W. T. W.

535.242.49

4597. Photometric comparison of Se photocells with compensating filters. KAPNIK, M. S. AND YUROV, S. G. *J. Tech. Phys., USSR*, **18** (*No.* 5) 573–8 (*May*, 1948) *In Russian.*

535.243

4598. Photographic spectral sensitometry with a biprism. CADY, W. M. AND GORDON, G. *J. Opt. Soc. Amer.*, **39,** 368–9 (*May*, 1949).—A method is described whereby spectral sensitometry is facilitated by the addition of a biprism to the optical train within a spectrograph. The modified instrument affords a spectrogram divided into 3 zones of relative intensities ½, 1, ½. In any spectral region, the characteristic curve of the emulsion can be determined from transmittance measurements on line images in all 3 zones. Although rather similar to the use of a step filter, the method has advantages over other techniques for homochromatic sensitometry. A.

535.243

4599. A new spectrophotometer employing a glass Fery prism. MILLER, W. C., HARE, G., STRAIN, D. C., GEORGE, K. P., STICKNEY, M. E. AND BECKMAN, A. O. *J. Opt. Soc. Amer.*, **39,** 377–86.—Describes the application of a borosilicate crown glass Fery prism as the dispersive element in a monochromator covering the spectral range from 320–1 000 mμ. Performance characteristics of the prism are given. A new Beckman spectrophotometer employing the Fery prism

is described with its performance characteristics. A novel wavelength control mechanism and a new slit device are described. A.

535.243

4600. An auxiliary working standard equivalent to magnesium oxide on a general electric spectrophotometer. GABEL, J. W. AND STEARNS, E. I. *J. Opt. Soc. Amer.*, **39**, 481–3 (*June*, 1949).—A method of obtaining spectrophotometric data plotted directly, relative approximately to magnesium oxide yet using glass samples, is described. The method consists of measuring a glass filter in series with the reflectance sample and using an opaque white glass as the reference sample. The transmitting glass is chosen so that over the wavelength range of interest its transmittance ∼ the ratio of the reflectance of the opaque white glass to the reflectance of magnesium oxide. A.

535.31

4601. Generalization of the concept of isoplanatism. SANCHEZ, DEL RIO C. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 457–66 (*July–Aug.*, 1948) *In Spanish.*—It is suggested that an optical system should be so corrected for astigmatism, that the circle of least confusion remains unchanged in size for small displacements perp. to the axis. The corresponding condition is less restrictive than that holding when the form of the whole caustic surface is required to remain constant. L. P.

535.311

4602. Some practical applications of a precision alignment method. VAN HEEL, A. C. S. *Appl. Sci. Res.*, **B1** (*No.* 4) 306–24 (1949) *In English.*—A precision alignment method is described, making use of a single slit, a double slit and a cross wire with eye-piece. By making the pointings on the transition colours in the interference pattern the precision attained with these simple means is of the order of 0″·1, or 0·01 mm in transverse deviation, for distances of from 3 to 60 m. Used as a means of determining the position of a mirror, it compares favourably with the common methods in use, except for registration purposes. The angular error can be lowered by making use of large distances, or for differential measurements of a collimating device. The linear error can be lowered for shorter distances. The method has proved useful in some practical cases. Those described are: the speeding up of the construction of a large steel bridge, the determination of the amplitude of a church tower under influence of the ringing of the bells, determination of the deflection of a reinforced concrete beam when loaded. A modification of the method, making use of circular openings, proved useful in the simultaneous alignment in 2 lateral directions, of importance, for example, for the alignment of ship's propellor shafting of large dimensions. Here the same precision proved attainable. A.

535.311

4603. An optical device facilitating accurate alinement. BROCKMAN, R. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 231–3 (*July*, 1949).—A device combining the angle-measuring properties of an auto-collimating telescope with that of lateral displacement indication is described. Both the measurements may be made at the same time; the method is essentially a develo ment of the process for centring lenses prior "edging."

535.3

4604. Oblique reflecting systems. LEE, B. *J. Opt. Soc. Amer.*, **39**, 487–9 (*June*, 1949).—T system of mirrors which will deviate a ray by a angle D while rotating an image an angle R is suc that the dihedral angle A between the two mirrors in accord with $\cos A = \pm \cos D/2 \cos R/2$. T position of the common edge bears a fixed b simple relationship to the initial and terminal ra The system of two mirrors with fixed dihedral ang may be rotated about the common edge of the tw mirrors as an axis to provide, within limits, a co tinuous multiplicity of solutions. Design techniqu are included.

535.31

4605. On series of plane mirrors. BRAUER, *Optik*, **4** (*No.* 1) 51–64 (1948) *In German.*—A theo of imagery by mirror systems based on a vector for of the laws of reflection. It is applied to simple cas (e.g. Porro prisms). H. H. HO

535.3

4606. Analysis of para-elliptic reflector. GOLL BERG, B. AND BENSON, N. C. *J. Opt. Soc. Amer* **39**, 497–500 (*June*, 1949).—Presents an analysis the para-elliptic reflector together with its possib applications when used as a searchlight mirror. T horizontal sections of a para-elliptic mirror a portions of ellipses and the vertical sections a parabolas. The mirror is so designed that eac parabola lies in a vertical plane through the seconda focus of the horizontal ellipse which passes throug the vertex of the mirror and each elliptical section li in a plane parallel to that of the ellipse through t vertex of the mirror. A beam of light projected fro such a reflector converges in the horizontal planes a line common to the intersection of the vertic planes and then diverges as a spread beam horizontal with minimum spread vertically.

535.31

4607. Note on autocollimating systems. PAGÈS, *Bull. Soc. Franç. Elect.*, **8**, 545–51 (*Nov.*, 1948) *French.*—The autocollimating systems used for sig reflectors are of two types, viz. the corner-cube an the double hemisphere with back silver. The autho gives a theoretical treatment of the light distributio from the latter system with different relative size of the two components. The requirement for a apparent luminous intensity of at least 0·1 cand per lux of illumination, with a field of ±15° vertic and ±30° horizontal, has, by careful design, bee met with a reflector some 25 cm² in area. The us of a phosphorescent material in place of the silverin to give a sign that can be followed with a u.v. hea light, is described. J. W. T. W

535.313

4608. On the theory of the zonal Foucault tes LINFOOT, E. H. *Mon. Not. Roy. Astr. Soc.*, **10** (*No.* 6) 428–44 (1948).—Ray theory is shown to b inadequate for discussing the systematic errors an limiting accuracy of the zonal knife-edge test applie to paraboloid mirrors. The diffraction theory of th

test is developed. With certain precautions the zonal readings are not affected by the finite size of the pin-hole nor by interaction between the apertures. Systematic errors are therefore inappreciable, and the accuracy is restricted only by the observer's limited power of brightness-discrimination. A. HU.

535.316

4609. On the prismatic properties of ophthalmic lenses. SAFONOV, G. AND GRAHAM, R. *J. Opt. Soc. Amer.*, **39**, 406–8 (*May*, 1949).

535.317

4610. A new method for the measurement of aberrations. DURÁN, A. AND SÁNCHEZ, DEL RIO C. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 489–510 (*Sept.–Oct.*, 1948) *In Spanish.*—Rays from the optical system are selected by means of a slit and fall on a cylindrical mirror placed along the optic axis near the focus. The reflected rays describe a curve on a suitably placed screen, from whose shape the aberrations may be calculated. L. P.

535.317

4611. Considerations on coma and the sine condition. MORAIS, C. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 149–64 (*March–April*, 1948) *In Spanish.*—Formulae are given for the third and fifth order sagittal coma. L. P.

535.317.3

4612. The choice of glasses for achromatic objectives. MORAIS, C. AND DURÁN, A. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 403–8 (*July–Aug.*, 1948) *In Spanish.*—A graphical method is given for the choice of the types of glass most suited to correct a 3-lenses objective for secondary spectra. L. P.

535.317.3/.4

4613. Considerations on the spherico-chromatic aberration. MORAIS, C. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 165–74 (*March–April*, 1948) *In Spanish.*—It is proved that the best correction is obtained by annulling longitudinal chromatism for rays at distance $a/\sqrt{2}$ from the axis. L. P.

535.317.4 : 612.84

The spherical aberration of the eye. *See Abstr.* 5178

535.317.5

4614. The distribution of light in a frontal plane in the presence of third-order spherical aberration. MORAIS, C. AND CASAS, J. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 305–18 (*May–June*, 1948) *In Spanish.*

535.317.5

4615. Laws of formation of the *r*.th order aberrations. EGÜES, M. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 556–67 (*Nov.–Dec.*, 1948) *In Spanish.*

535.317.5

4616. General study of the *r*.th order aberrations. EGÜES, M. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 568–73 (*Nov.–Dec.*, 1948) *In Spanish.*

535.317.5

4617. The 9th order aberrations compared with those of lower order. MORAIS, C. AND EGÜES, M. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 523–56 (*Sept.–Oct.*, 1948) *In Spanish.*—A systematic study is made of the aberrations of a plane-parallel plate in air, following a general method given by one of the authors [*Optica*, **3** (1943)]. L. P.

535.317.6

4618. Decentered optical systems. STEPHAN, W. G. *Appl. Sci. Res.*, **B1** (*No.* 4) 273–83 (1949) *In English.*—The aberrations caused by decentration have been derived and expressed in paraxial quantities. A very rapid method of calculation has been developed. From an example it is shown that second order terms (the first occurring in the expansion) suffice to obtain the order of magnitude of the aberrations. A.

535.321

4619. A method for the determination of the index of refraction of thin transparent films. STEWART, R. W. *Canad. J. Res. A*, **26**, 230–5 (*July*, 1948).—A pair of half-silvered plates is prepared, as for a Fabry–Perot interferometer; one of these is placed in a discharge tube for some hours, thus forming a thin deposit; from the double fringe system formed by the two plates, the mean refractive index of the transparent deposit is calculated. If the tube is of pyrex or quartz, the refractive index for sodium light is 1·487, which agrees within experimental error with that of the cristobalite form of silica. Polystyrene tubes cause a deposit whose refractive index increases with thickness, but which is always $<$ that of the polystyrene in bulk. It is tentatively suggested that this is due to varying amounts of free space in the film. N. C.

535.321

4620. A new method for the precise measurement—by immersion—of the refractive index of a lens or any other optical part. OTERO, J. M. AND PLAZA, L. *An. Real Soc. Esp. Fis. y Quim.*, **44**, 395–402 (*July–Aug.*, 1948) *In Spanish.*—The liquid is contained in a hollow prism mounted on a spectrometer, and matching is tested by an interference method. L. P.

535.322.1

4621. A recording spectrometer for Raman spectroscopy. MILLER, C. H., LONG, D. A., WOODWARD, L. A. AND THOMPSON, H. W. *Proc. Phys. Soc., Lond. A*, **62**, 401–7 (*July*, 1949).—A description is given of a spectrometer incorporating a high-intensity excitation system and a novel amplification device. Operation of the exciting Hg arc lamps from 50 c/s mains imparts to the light signal, and consequently to the current from the photo-multiplier tube, a 100 c/s periodicity. After amplification by a narrow band-pass amplifier, rectification is achieved in a push-pull phase-sensitive (homodyne) rectifier, by "mixing" the signal with a fixed voltage of identical periodicity. The rectified signal is fed through a filter to a cathode follower valve which provides the power to operate a recording milliammeter. This method of rectification, in conjunction with appropriate filter, effectively reduces the bandwidth of the amplifier, with consequent great improvement in the signal/noise ratio. With this arrangement cooling of the photo-multiplier is unnecessary for normal work. Using a spectrometer of small aperture and resolution and a Raman tube of 35 ml capacity, traces of the Raman spectrum of CCl_4 show no appreciable background noise. A.

535.322.1

4622. Optical conditions in the use of photo-electric cells in spectrographs and interferometers. JACQUINOT, P. AND DUFOUR, C. *J. Rech. Cent. Nat. Rech. Sci.*

(*No.* 6) 91–103 (1948) *In French.*—From considerations of the spread of the image of a slit due to diffraction and scatter in the photographic emulsion it is shown that increased resolution implies reduced luminosity, the best compromise being obtained when the diffraction image of the slit is equal to the spread in the emulsion. A photographic spectrograph must be designed either for high resolution or luminosity; a universal instrument is not possible. With a photo-electric cell, which responds to total flux (not luminosity), it is shown that a universal instrument is possible. The optimum slit-size and slit-magnification are considered. A similar treatment is applied to the case of a photo-cell used with the Fabry–Perot interferometer. H. H. HOP.

535.322.1

4623. Thallium bromide-iodide prism spectroscopy in the far infra-red. HYDE, W. L. Letter in *J. Chem. Phys.*, **16**, 744–5 (*July*, 1948).—An 18° TlBr/TlI prism was used to 37 μ. Absorption cells had polythene windows, while the replacement of an Al surfaced mirror by a LiF reflector reduced stray light. Bands observed include one of CH_3CCl_3 at 343 cm^{-1}. Deterioration of the prism (0·3% in angle) was noticed after 5 months. D. H. W.

535.322.1

4624. Approximation formulae for resolution and radiation density in relation to slit width. KAISER, H. AND HANSEN, G. *Spectrochim. Acta*, **3** (*Nos* 3–4) 433–5 (1948) *In German.*—Schuster's values for resolution and radiation density in the spectrum are compared with those derived from empirical expressions for the effective image width. S. T. H.

535.322.4

4625. Recording differential refractometer. ZAUKELIES, D. AND FROST, A. A. *Analyt. Chem.*, **21**, 743–5 (*June*, 1949).—An improved and simplified recording differential refractometer has been constructed. Its sensitivity is of the same order of magnitude as obtained with an interferometer. The previously used beam-splitting method, as described by Claesson, has been simplified by the use of a twin-cathode phototube. Pen and ink recording is used. A.

535.323

4626. The optical constants of germanium in the infra-red and visible. BRATTAIN, W. H. AND BRIGGS, H. B. *Phys. Rev.*, **75**, 1705–10 (*June*, 1949).—Thin films of Ge have been evaporated on glass, quartz, and calcium fluoride slides. The thickness of these films ranged from 4×10^{-6} to 1×10^{-4} cm. Transmission of infrared light through the films exhibited the usual interference phenomena, showing alternate maxima and minima as the wavelength was varied. From these the index of refraction of the films was determined. This index was 4·3 for $\lambda > 6\times10^{-4}$ cm wavelength. It increased to 5·2 at $8\cdot0\times10^{-5}$ cm and then fell off rapidly to 2·3 at $4\cdot0\times10^{-5}$ cm. To determine the values of the index and extinction coefficients in the visible region where the absorption is large, a wedge of germanium was made. Transmission was then determined as a function of film thickness for several wavelengths. The values of the optical constants in this region were then obtained by comparing these results with the theoretical transmission equations. The extinction coefficient in creased from 0·4 at $\lambda = 1\times10^{-4}$ cm to 2·8 a $\lambda = 4\times10^{-5}$ cm. The density of the films wa determined by an interferometric method and wa found to be the same as bulk Ge. The real an imaginary parts of the dielectric constant for Ge a calculated and compared with the known results for S The absorption bands for both elements are show to be consistent with the electron band structur deduced from their semiconducting properties. A

535.33 : 539.15

4627. Investigations of electron shells by spectro scopic methods. KOPFERMANN, H., FINKELNBURG, W HOYER, H., GOUBEAU, J., SCHÄFER, K. AND FÖRSTER, T *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Gov Germany*] "*Physics of the electron shells, I,*" 1–6 (1948) *In German.*—The booklet is a summary i three parts of work done in Germany. Nearly 30 references are quoted. *Atomic spectra*: The hyperfin structure of H has not been explained by Somme feld's suggested variation of the coulomb fiel The quadratic Stark effect has been investigated b means of completely modified experiments using field strength of up to 300 kV/cm. Resolution better than 2×10^6 were obtained. The quadrat Doppler effect of a light source moving with a veloci v which approaches the velocity of light c, is give by $\Delta\lambda = \lambda_0(-vc^{-1}\cos\theta + 0\cdot5v^2c^{-2})$. This effe produces a red shift independent of the angle θ observation. Experimental proof of the quadrat Doppler effect has been attained. Contrary Fermi's theory of the pressure shift of the hig absorption series which demands a shift towards re experiments have proved that the shift takes pla towards the violet end of the spectrum and is $\propto$ t relative density of the gas. The shift was towar violet in both systems investigated, viz. Rb I + N and K + He. *Continuous spectra*: Electrons, whi are stopped in the fields of positive ions cause a ve intensive continuous spectrum to be emitted. It possible that this radiation [Elektronenbremsstrahlun will play an important role in the production of ve high intensity light sources. Spark discharges throu capillaries filled with various gases attained curre densities up to 170 000 A/cm². Below 70 000 A/c the sparks showed, predominantly, a line spectru Above that density, the continuous spectrum sudden becomes predominant. The total radiation intensi is $\propto$ the square of the max. spark current. For t production of a very high intensity continuous H u spectrum, a new spectral tube was constructed usi a continuous flow of H. The continuous u.v. radi tion of the H-atoms in the heads of the prominenc of the sun (10 000°K) is much more powerful th that from the surface (6 000°K) and is an importa contributing factor in the production and maintenan of the terrestrial atmosphere. The corona of t sun emits a still more powerful continuous u radiation. A high intensity continuous radiati reaching from the u.v. (λ1849) into the i.r. has be produced by W arcs in Ne, Ar, Kr and Xe. T atmospheric pressure was 35 atm. and the arc curre 30 A. Several metal vapour (Hg, Cd, Zn, Tl) a and the S vapour arc have been found to emit continuous i.r. spectrum between 150 and 400

As a working hypothesis this radiation has been assumed to be a radiation caused by electron retardation [Elektronenbremsstrahlung]. Observations on extreme intensity spark discharges in various gases will lead to data which are of interest to the physics of high temperature plasma. *Molecular spectra*: A compensated thermionic bridge using a cesium cell as photoelectric pickup permits the exact measurement of variations in i.r. absorptivity as small as 0·1%. The emission in the extreme i.r. of a high pressure Hg vapour arc was shown to be a continuum between 150 and 400 μ and of black body character. Measuring devices and receivers (radiometers) for the range of from 150 to 400 μ have been built. A direct recording i.r. spectrograph, operating in the region 1 to 14 μ, takes about 30 min to make a complete record. The accuracy in measuring the absorption is 1% and the wavelength is given accurate to 400 Å. The absorption spectrum of H_2O and D_2O has been measured between 14 and 26 μ. This spectrum, it has been argued, is not a rotation spectrum. In studying the intermolecular H bridges it was found that certain lines in the i.r. were shifted so much that they came into close vicinity of CH-absorption. The difficulty of superimposed —OH and —CH absorptions was avoided by introducing into one of the two groups a D atom instead of the respective H atom. A newly developed equipment for the study of Raman spectra of solids uses high intensity light sources arranged in the foci of an elliptic reflector. The instrument has been designed for work at low temps. as well as for a continuous flow of material past the light sources if such material would deteriorate if exposed for any length of time to the intense light. A mechanical model was built for demonstrating the oscillations of molecules. The oscillations of 8 different molecular systems were filmed. A new method has been developed for finding the configuration of normal molecular oscillations. A method has been worked out for calculating the intensities of Raman lines in binary systems. A simple formula gives the "dispersive capacities." In ternary systems the formula becomes more complicated. Experiments, broken off in 1942, were carried out on the question of the transmission of energy by means of nuclear oscillations. It was found that the transmission seemed to start easier when the impact was received in the direction of the axis of symmetry of the molecules. Work has been done on the absorption spectra of pyrrol dyes, chlorophyll derivatives, and of the steroids. Investigations on fluorescence spectra include work on quinine sulphate, anthracene and hyperizine. The reduction by 50% of the fluorescence of polymers which, using brenzcatechin (catechol), takes place at concentrations of 10^{-4} mol/litre, is an anomaly when compared with normal fluorescent dyestuffs which do not react until a hundredfold stronger concentration has been reached. W. S.

535.33.071

4628. Multi-slit spectrometry. GOLAY, M. J. E. *J. Opt. Soc. Amer.*, **39**, 437–44 (*June*, 1949).—The factors which limit the recording speed and the resolution of infrared spectra are reviewed, and methods offering increased overall photometric efficiency are examined. The attainment of greater efficiency by means of multi-slit arrangements is discussed and the experimental results are described. A.

535.33.072

4629. Some new techniques in the construction of spectrographic absorption cells. KIVENSON, G., ROTH, A. AND RIDER, M. *J. Opt. Soc. Amer.*, **39**, 484–6 (*June*, 1949).—Several designs are presented for the construction of pressure absorption cells for use in the infrared and ultraviolet. A.

535.331 : 536.52

4630. Measurement of the relative transition probabilities of some lines of Cr II and determination of the temperature of a condensed spark between steel electrodes. ZAGORYANSKAYA, E. V. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 447–50 (*May*, 1949) *In Russian.*—The measurements were carried through in the arc spectrum between C electrodes by measuring the relative intensities of the Cr II lines; the temperature of the condensed arc between steel electrodes then also being determined from the Cr II lines. B. F. K.

535.331

4631. The spectra of the heavy elements. TOMKINS, F. S. AND FRED, M. *J. Opt. Soc. Amer.*, **39**, 357–63 (*May*, 1949).—The spectra of the new heavy elements are characterized by great complexity similar to that well known for Th and U. Consequently descriptions of the spectra to be adequate for term analyses and assignment of electron configurations must be quite extensive, containing complete, accurate wavelengths and much other material. Since considerable effort and amounts of sample are required it will be some time before such descriptions are available. On the other hand it would be useful for spectrochemical analyses to have wavelengths to 0·1 Å and intensities in a convenient spectral region, and this information has been collected for Pa, Np, Pu and Am. Intensities for each line were obtained as the reciprocal of the limiting dilution at which it could be seen with the Cu spark source, and therefore the same intensity scale is used for each element. Hence it could be observed that the spectrum of Am appears to stand in the same relation to those of the other heavy elements that the spectrum of Eu does to those of the preceding rare earths, both elements containing relatively few lines of high average intensity. This suggests by analogy that Am I contains 7 *f* electrons plus 2 others. A.

535.331

4632. Spectrum of nickel in the vacuum arc, 2 991–8 968 A. BURNS, A. K. AND SULLIVAN, F. *Sci. Stud., St. Bonaventure Coll.*, **13** (*No.* 3) 32 *pp.* (1947).—Seven-figure $\lambda\lambda$ of nearly 1 200 Ni lines ranging from 2 991·106 to 8 968·140 Å are reported. The majority have been measured relative to Ne standards recorded simultaneously with Fabry–Perot interferometers and stigmatic spectrographs. $\lambda\lambda < 3\,500$ Å were compared with Fe and Cu standards. $\lambda\lambda$ of some lines were computed from term vals. fixed by the interferometer measurements. Most of the Ni lines are identified in the solar spectrum. B. A.

535.332

4633. The spectra of argon, krypton, and xenon between 1·2 and 2·2 microns. SITTNER, W. R. AND

PECK, E. R. *J. Opt. Soc. Amer.*, **39**, 474–7 (*June*, 1949).—The spectra, excited by a repetitive condenser discharge method, have been studied in the near infrared region. The use of this method of excitation and a large infrared spectrograph using a PbS detector reveals about 170 new lines in these gases. About ¾ of the lines are classified by known terms of the normal atom. Some anomalies of spectra excited by the repetitive condenser discharge method are mentioned. A.

535.332

4634. Spectrum of iodine VII. FERNANDO, I. Letter in *Curr. Sci.*, **17**, 362 (*Dec.*, 1948).—From the data for lines in the spectrum of I in the wavelength region 200 to 1 000 Å [Abstr. 5331 (1937)], doublets are selected thought to belong to I VII, since they fit in with the irregular doublet law for corresponding lines in Ag I—like spectra. Other supporting facts are stated. A. C. M.

535.333

4635. On the flame spectrum of CuCl. SINHA, S. P. Letter in *Curr. Sci.*, **17**, 208–9 (*July*, 1948).—Wavelength measurements are given for additional possible CuCl bands in the region λλ3500–4000. The spectrum was flame excited and it is thought that the new bands are higher members of previously known sequences. A. H.

535.333

4636. Manganese chloride emission bands. RAO, P. T. Letter in *Curr. Sci.*, **17**, 209 (*July*, 1948).—Bands of MnCl are excited by means of a heavy current discharge from a 2 000 V d.c. generator. 7 sequences are observed in the region λλ3500–3900. Details of the analysis are not given but it is stated that Cl isotopic shifts support the analysis. Constants are quoted as $\omega'_e = 412{\cdot}0$, $\omega''_e = 384{\cdot}1$. A. H.

535.337

4637. The significance of temperatures derived from emission spectra. PETRIE, W. *Amer. J. Phys.*, **16**, 378–82 (*Oct.*, 1948).—The detection of spectral lines in an atmosphere is an indication of departure from thermal equilibrium. Hence, varying significance is to be attributed to temp. data derived from emission spectra. It is customary to determine temps. of distant bodies by measuring the total radiation emitted, e.g., by a star (the "effective temp.") or by studying the intensity distribution of the radiation (the "colour temp."). When neither of the above methods is applicable, the Boltzmann distribution equation (yielding the "excitation temp.") or the Saha equation may be used. If the spectrum contains lines from the same element in 2 or more stages of ionization, one form of the Boltzmann equation will give the "ionization temp." The "electron temp." may be obtained from the continuous emission which in certain cases appears at the limit of a spectral series. In general, effective, colour, excitation, ionization, and electron temps. differ for an assemblage of particles, unless the particles are in thermal equilibrium. F. L.

535.338

4638. Term representation for atoms with 2 electrons. DZIWOKI, A. *Ann. Phys., Lpz.*, **43** (*No.* 8) 579–97 (1943) *In German.*—Spectral terms of H-like series are usually represented by $R/(m+a)^2$ where m is a integer and a a correction term. It is claimed that more correct empirical representation is obtained i the form $R/n^2 + A/u$ where A is a constant and u a integer. As n runs through the sequence of natur numbers, u runs through a sequence of integers wit constant fourth difference. It is attempted to prov this by considering many examples of spectral serie The question as to whether the numbers u are reall integers is not answered conclusively. The princip is generalized for spectra involving 1 or > 3 electron H. M

535.338

4639. The influence of extraneous elements on lir intensity. IV. Extraneous element effects in th direct-current arc. BRODE, W. R. AND TIMMA, D. I *J. Opt. Soc. Amer.*, **39**, 478–81 (*June*, 1949).—Th effect of varying amounts of extraneous element upo the line intensity of different elements has bee investigated. Slavin's total energy method was use to make possible a more direct correlation than ha been achieved using the internal standard metho The results of this study indicate that the effect o the extraneous element varies with the amount o extraneous element, but not in a simple linear fashio The effect of an extraneous element on a group o lines of an element ending at the same energy lev or beginning at the same energy level, is the sam The experimental results show that the elements ca be arranged in a series bases on their interelemen effects in the d.c. arc. An arrangement of the elemen in a series based on their boiling points and excitatio potentials is in agreement with that found exper mentally.

535.338

4640. The calculation of the absolute strengths spectral lines. BATES, D. R. AND DAMGAARD, A *Philos. Trans.* (*No.* 842) 101–22 (*July* 5, 1949).—It shown that in calculating transition integrals it permissible to neglect the departure of the potenti of an atom or ion from its asymptotic Coulomb for This enables a general analytical expression for th transition integral to be derived. Tables are compile from which the absolute strengths of large numbe of spectral lines can at once be obtained if the ter values of the upper and lower levels are know *s–p*, *p–d* and *d–f* transitions are all treated. Com parison with experimental data shows that for th simpler systems (i.e. systems with a single electro outside closed shells) the method gives remarkab accurate results; indeed, it appears superior to th normal rather laborious procedure involving th computation of the necessary wave functions, in eac individual case, by solution of the appropria Hartree or Fock differential equation. The metho (in its most elementary form) may not be so sati factory for complex systems (i.e. systems with unclose shells) owing to difficulties associated with th identification of certain energy parameters. Howeve the rather scanty comparison data available sugge that even for such systems it yields useful (and some cases precise) information on the line strength In the course of the work the accuracy of a few wa functions based on the self-consistent field approx mation (including exchange) was tested by usi

them to evaluate line strengths from both the dipole moment and the dipole velocity formulae. Appreciable defects were revealed. A.

535.338.332

4641. Interval formula for multiplets of atomic energy levels. I. ARAKI, G. *Progr. Theor. Phys.*, **3**, 152–9 (*April–June*, 1948) *In English.*—A formula is obtained in the Russell–Saunders case (L and S good quantum numbers) for the multiplet splitting due to both spin-spin dipole and spin-orbit coupling. The levels are given by the formula $AK + B\{3K(K+1) - 4L(L+1)S(S+1)\}$ where $K = J(J+1) - L(L+1) - S(S+1)$ and A and B are constants. This is successfully applied to a few multiplets where the Landé rule is not sufficient, and suggests that in these cases the spin-spin coupling is as large as the spin-orbit. G. J. K.

535.338.332

4642. Interval formulae for multiplets of atomic energy levels. II. ARAKI, G. *Progr. Theor. Phys.*, **3**, 262–75 (*July–Sept.*, 1948) *In English.*—The structure of a large number of multiplets has been found to agree with the formula deduced previously [preceding Abstr.] using empirical values of A and B_0. In some cases a term in B is introduced to account for small irregularities from the Landé structure. G. J. K.

535.338.333 : 539.155.2

4643. On the isotope shift effect in the spectrum of Ba I. KOPFERMANN, H. AND WESSEL, G. *Nachr. Wiss. Göttingen* (*No.* 2) 53–5 (1948) *In German.*—The hyperfine structure of the line at 5 536 Å was photometered before and after absorption by a beam of Ba atoms. A plot of absorption coeff. × thickness of absorbing layer v. frequency for the absorption line shows a main peak due to Ba^{138}, with a tail on the higher frequency side which is analysed by trial into smaller peaks attributed to the isotopes 137, 136, 135 and 134. The corrected value of the separation between peaks for isotopes differing by 2 units is given as $0{\cdot}016 \pm 0{\cdot}004\ cm^{-1}$. S. T. H.

535.338.4

4644. Intensity variations in the first positive and second positive bands of nitrogen excited by high frequency oscillations. ASUNDI, R. K. AND SINGH, J. *Proc. Indian Acad. Sci.*, **22**, 60–6 (*Aug.*, 1945).—A discharge tube containing air at low pressure was excited by h.f. oscillations from a modified Hartley circuit. 735 kc/s is a critical frequency of exciting oscillations below which the colour of the discharge is pinkish red and above, orange yellow. The spectrum of the discharge in the visible region consists of the 1st and 2nd positive bands of N. The 1st positive bands at 5 371, 5 406 and 5 441 Å decrease in intensity as the frequency of exciting oscillations is reduced from 790 to 680 kc/s. The second positive bands at 4 355, 4 417, 4 490, 4 649, 4 724, 4 815 and 4 917 Å increase in intensity under the same conditions. The results agree with the theory, and it is concluded that an energy of 15 eV is available for excitation when oscillations of frequency 735 kc/s are used. A.

535.34 : 545.82

4645. Refinement in quantitative absorption spectrophotometry. EDISBURY, J. R. *Spectrochim. Acta*, **3** (*Nos* 3–4) 420–32 (1948) *In English.*—It is recommended that the use of optical density standards should be routine in all estimations. The errors controlled by such use are discussed at length. Details are given of some minor instrumental modifications. A. H.

535.34–14 : 537.226 : 539.133

4646. Ultra-Hertzian spectra and molecular structure. I–III. FREYMANN, M., FREYMANN, R. AND LE BOT, J. *J. Phys. Radium* (*Sér.* 8) **9**, 1*D*–28*D* (*Oct.*); 29*D*–44*D* (*Nov.*); 45*D*–60*D* (*Dec.*, 1948) *In French.*—I. Complete and concise account of the associated equipment and of the techniques used for measuring dielectric constants and absorption losses in gases, liquids and solids for wavelengths from 100–0·5 cm. 80 references, 65 figures. II. A general account of the types of spectra observed and of the derivable results. 15 figures. III. Extensive list of references relating to II. D. H. W.

535.343

4647. [Photographic] spectroscopic method for determination of absorption coefficients. MARKS, G. W. AND LUKENS, H. C. *Rep. Invest. U.S. Bur. Mines* (*No.* 4242) 8 *pp.* (1948).—Grating spectrograms are taken through $\not< 2$ different thicknesses of the material on plates previously calibrated by means of a stepped sector. From the optical density so determined, the absorption coeff. (α) is calc. by Lambert's law. The light source is a d.-c. electronically controlled Fe arc. An α–λ curve for soda glass over the range 1 950–3 550 Å agrees with values calc. by Cauchy's dispersion equation. B. A.

535.343

4648. Absorption spectrum of methyl iodide in the near infrared. HERZBERG, G. AND HERZBERG, L. *Canad. J. Res. B*, **27**, 332–8 (*April*, 1949).—The absorption spectrum of CH_3I in the region 8 500 to 25 000 Å has been investigated with an absorbing path of 30 m and pressures up to 200 mm. A large number of bands has been found most of which can be readily classified as $\parallel$ or $\perp$ bands. An assignment of many of these bands to specific overtones or combinations of the fundamentals is suggested. In a number of instances the splitting of binary or ternary combinations of degenerate vibrations on account of anharmonicity is established and found to be in agreement with theoretical predictions. A.

535.343

4649. Absorption and fluorescence spectra of bivalent samarium, europium and ytterbium. BUTEMENT, F. D. S. *Trans. Faraday Soc.*, **44**, 617–26 (*Sept.*, 1948).

535.343

4650. The infrared properties of magnesium oxide and their interpretation. BURSTEIN, E., OBERLY, J. J. AND PLYLER, E. K. *Proc. Indian Acad. Sci.*, **28**, 388–400 (*Nov.*, 1948).—New determinations of the infrared absorption and reflection curves of MgO show that they do not differ in form from those of other NaCl-type crystals. Detailed comparison of MgO with LiF, NaF, NaCl and KCl, for which accurate data are available, reveals a correlation between the amount of coupling of vibrational modes and the amount of homopolar bonding and ionic

overlapping. It is suggested that the coupling is primarily associated with the change in polarizability of the ions during vibration rather than with anharmonic vibrations as proposed by existing theories. A.

535.343

4651. Laws concerning the alteration with temperature of a continuous absorption spectrum. HERCZOG, A. AND WIELAND, K. *Helv. Phys. Acta*, **21**, 436–44 (*Dec.* 20, 1948) *In German.*—Absorption curves of HgI_2 vapour in the region 2 500 to 3 800 Å were taken at various temps. between 160° and 1 100° C. All the curves passed approximately through one point, at 2 930 Å. A second empirical relation was that the curves intersected the abscissa of any arbitrary value of $\log \varepsilon$ at wavelengths linearly related to the corresponding temps.; hence the calculation of absorption curves is possible for temps. outside the experimental range. Earlier work, especially that of Gibson, Rice and Bayliss on Cl, gives confirmatory evidence. S. T. H.

535.343 : 548.7 : 539.132

Electronic and vibrational levels of the naphthalene crystal and molecule. *See Abstr.* 4914

535.343–15 : 539.132

4652. Characteristic infra-red frequencies and chemical properties of molecules. FLETT, M. ST. C. *Trans. Faraday Soc.*, **44**, 767–74 (*Oct.*, 1948).—A close parallelism is found between the exact i.r. frequencies and relative reaction rates in series of related compounds; as, for instance, between the C = O stretching frequency and the rate of esterification in substituted benzoic acids. The same electronic effects must control both quantities. D. H. W.

535.343.2 : 548.0

Investigations on the infra-red spectra of crystals. *See Abstr.* 5095

535.343.3–31

4653. The ultimate liquid transmission limit? KLEVENS, H. B. AND PLATT, J. R. Letter in *J. Chem. Phys.*, **16**, 1168–9 (*Dec.*, 1948).—Refractionated n-C_8F_{18} transmits to 1 592 Å in a 0·5 mm layer and this substance is the best solvent for far u.v. spectroscopy, surpassing n-heptane. D. H. W.

535.343.32 : 539.133

4654. The absorption spectra of the rare earths. HOOGSCHAGEN, J. *Univ. Leiden, Acad. Diss.* (*N.V. Noord-Hollandsche Uitgevers Maatschappij*) 119 *pp.* (1947) *In Dutch, summary in English.*—Prior to the investigation proper the apparatus, comprising an h.p. Hg lamp, a grating in Runge–Paschen mounting, and photo-cell with 3-stage current amplification was most carefully checked in every possible direction, and comparative tests by a photographic method were made. These showed the considerable superiority of the photo-electric method. Furthermore, a general relation for the light transmission of a monochromator was derived. Its application to the prism and grating monochromator shows that the grating, at the same resolving power, is not inferior to the prism in absorption spectroscopy. The visible and ultraviolet maxima observed are in good agreement with Prandtl and Scheiner's results. The intensities for the areas of absorption bands were calculated in terms of classical oscillators, and given in tabulated form. In the theoretical discussion of the experimental data it is pointed out that the observed bands must be ascribed to transitions within the incomplete, shielded 4*f* shell. In free ions the transitions are forbidden for electric dipoles by the Laporte selection rule. Of the 3 possible explanations of the multipole character of the bands, viz. electric dipole transitions, magnetic dipole, and electric quadrupole transitions, the last one has to be dismissed, because its absorption is far too weak to produce the observed intensities. The observed magnetic dipole bands are always weak, and can occur only in a few cases. They are intercombination bands. Electric dipole transitions are caused by the high intermediate levels of the excited states due to the internal e.s. field. Statical transitions, due to the equilibrium field, and vibrational transitions, due to fluctuating thermal vibrations, are possible, the latter somewhat weaker. The spectra of Pr^{+++}, Tm^{+++} and Yb^{+++} are the simplest and only ones to have been satisfactorily analysed, and all observed bands must be electric dipole bands; accurate calculations give good agreement for the first two. However, two abnormally strong intercombination bands, even in these, are difficult to explain. Two Eu^{+++} bands and part of one Dy^{+++} band were shown to be of magnetic dipole character.

535.343.32–1

4655. Infra-red analysis of stereoisomers of "benzene hexachloride" (hexachlorocyclohexane). WHIFFEN, D. H. AND THOMPSON, H. W. *J. Chem. Soc.*, 1420–1 (*Sept.*, 1948).

535.343

4656. Microwave methods in physics. I. Microwave spectroscopy. KIKUCHI, C. AND SPENCE, R. D. *Amer. J. Phys.*, **17**, 288–97 (*May*, 1949).

535.343

4657. The microwave absorption spectrum of oxygen. STRANDBERG, M. W. P., MENG, C. Y. AND INGERSOLL, J. G. *Phys. Rev.*, **75**, 1524–8 (*May* 1, 1940).—Measurements of the absorption of 5 mm radiation in oxygen gas have been made. The experimentally observed magnitude and shape of the absorption may be satisfactorily compared with the theoretical curves of Van Vleck for an assumed line breadth $\Delta\nu = 0{\cdot}015$ to $0{\cdot}02\ cm^{-1}$. Observations on the absorption in mixtures of O and N indicate a disparity of O_2 and N_2 collision cross-sections. It is suggested that N causes an anomalous narrowing of the O absorption line breadth.

535.343.4 : 545.8

Microwave spectra and chemical analysis. *See Abstr.* 5086

535.343.4–14 : 539.13

4658. The rotational spectrum of ethylene oxide. CUNNINGHAM, G. L., LEVAN, W. I. AND GWINN, W. D. Letter in *Phys. Rev.*, **74**, 1537 (*Nov.* 15, 1948).—11 lines from 23 000 to 40 000 Mc/s have been detected and identified with the aid of their Stark effect. Derived moments of inertia are 32·921, 37·926 and $59{\cdot}510 \times 10^{-40}$ g-cm². (See Abstr. 3879 (1949)].

D. H. W.

535.343

4659. A reinvestigation of the vibration spectrum of ozone. WILSON, M. K. AND BADGER, R. M. Letter

n *J. Chem. Phys.*, **16**, 741–2 (*July*, 1948).—Fundamental frequencies at 705, 1 043 and 1 110 (new band) cm^{-1} account for the combination bands and the rotational structure if an obtuse-angled triangular model is assumed. D. H. W.

535.345 : 541.182

4660. Optical transmission of a colloidal solution in a magnetic field. STOTT, F. D. *Proc. Phys. Soc. B*, **62**, 418–30 (*July*, 1949).—The change in optical transmission of a solution of colloidal graphite in a magnetic field has been measured as a function of a field strength and of concentration, and the results obtained compared with those to be expected from theory. It is found that the experimental results agree closely with the hypothesis that the change in transmission is due to the change in projected area of the plate-like particles when these are aligned by the magnetic field. By comparison of theoretical and experimental curves the particle volume is found. The rate of decay, after removal of the field, of the change in transmission produced by the field has also been measured. An approximate theory is given to connect this rate with the diameter of the particles, and from this the size of the particles has been calculated. The dimensions so found agree satisfactorily with evidence from other sources. A.

535.37 : 537.226.3

4661. Luminescence and dielectric losses of zinc silicate. SZIGETI, G. AND NAGY, E. *Publ. Univ. Tech. Sci., Budapest* (*No.* 1) 115–30 (1948) *In English.*—The spectral distributions in the luminescence of Zn silicate and ZnBe silicate activated with Mn have been obtained with a photomultiplier. Each curve is analysed into 3 or 4 Gaussian error curves. The temp. dependence of luminescence is found to follow a similar law to that of the conductivity. The results are discussed theoretically. J. E.

535.371

4662. Optics of solids. II. Luminescence of solids. HANLE, W. AND SCHMILLEN, A. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 185–209 (1948) *In German.*—The subject is fully treated, the subheads including:—the effects of luminous intensity of exciting radiation, electrical properties including the change in dielectric constant on illumination found with certain ZnS, ZnSe and other phosphors, activators and killers, phosphors containing more than one activator, and mixed phosphors. Wesch treated certain substances at 300 atmos. and 1 200° C and by this means prepared and examined the selenide and telluride phosphors ZnS–ZnSe, ZnS–CdSe, ZnS–ZnTe, ZnS–CdTe, which are easily decomposed, together with combinations of the above with CdS and HgS. A band picture for the action of phosphors using the conception of activator and trapping levels is given. The luminescence of salts of the rare earths and of certain organic compound is discussed. C. A. H.

535.371

4663. Calcium halophosphate phosphors. NAGY, R., WOLLENTIN, R. W. AND LUI, C. K. *J. Electrochem. Soc.*, **95**, 187–93 (*April*, 1949).

535.371

4664. Radioactive tracer study of activator distribution in infrared phosphor systems: Effect of strontium oxide. PRENER, J., MASON, R. W. AND WARD, R. *J. Amer. Chem. Soc.*, **71**, 1803–5 (*May*, 1949).—An improved method is described for determining the distribution of rare earth activator ions between the solid and liquid phases present in infrared-sensitive phosphor systems. The distribution constants, defined as the ratio of the mole fractions of the rare earth ion in the solid and liquid phases, have been determined for the rare earths Sm, Ce and Eu in the systems SrS–$SrCl_2$–SrO and SrSe–$SrCl_2$–SrO. The distribution constants of Sm and Ce decrease rapidly as the ratio of strontium oxide to strontium chloride increases. That of Eu is relatively little affected by strontium oxide. These results explain qualitatively the observed brightness–composition variation in the phosphor SrS (Sm, Eu) $SrCl_2$, SrO. A.

535.371

4665. The long-term deterioration in certain phosphors exposed to the low pressure mercury arc. LOWRY, E. F. *J. Electrochem. Soc.*, **95**, 242–53 (*May*, 1949).—An expression for the decay in lumen efficiency of phosphors exposed to a Hg vapour discharge has been developed. This expression is of the form commonly associated with first order chemical reactions. Several experiments are described which show that the decay in fluorescent efficiency is caused by at least 3 more or less independent reactions of widely different velocities. A.

535.371

4666. The fluorescence of silicate phosphors. III. Application of potential energy curves. BUTLER, K. H. *J. Electrochem. Soc.*, **95**, 267–81 (*May*, 1949).—The fluorescence of silicate phosphors is discussed on the basis of a potential energy curve model and it is shown that Gaussian distributions of the energy bands in excitation and emission spectra can be expected from this model. The model is applied to Mn-activated phosphors and an attempt is made to explain the long decay time of these phosphors. Pb activated silicates are discussed and reasons for assuming divalent Pb to be the activator are brought out. The mechanism of sensitized luminescence is treated briefly in terms of the model, as well as the ways in which radiationless energy dissipation may take place. A.

535.371

4667. High valent manganese as activator of luminescence. MAKAI, E. *J. Electrochem. Soc.*, **95**, 107–11 (*March*, 1949).—It is shown that several properties of various Mn-activated phosphors can be explained on the assumption that their luminescent centres have MnO_4^- or MnO_4^{2-}-like configurations. A.

535.371

4668. The preparation of luminescent screens. SADOWSKY, M. *J. Electrochem. Soc.*, **95**, 112–28 (*March*, 1949).—The various methods used are discussed and evaluated on the basis of the relative importance of such factors as luminescence efficiency, uniformity, thickness, coverage, texture, colour, contrast, secondary emission, current saturation and facility of deposition. A.

535.371

4669. Theory of decay of luminescence of organic phosphors. SVESHNIKOV, B. YA. *J. Exp. Theor. Phys., USSR*, **18**, 878–85 (*Oct.*, 1948) *In Russian.*—The basic characteristics of the luminescence of organo-phosphors may in general be described on a model with a single metastable level. With these phosphors it is frequently observed that extinction of the fluorescence coincides with an extinction of the phosphorescence. There is a different effect of the extinction on the initial intensities of the short-wave and long-wave band of the phosphorescence. The former, corresponding to the fluorescence range of the spectrum, is extinguished more completely than the latter, which corresponds to the direct transition from the metastable into the normal state. This phenomenon is explained and formulae are given for the variations of the initial intensities of both phosphorescence bands, and of the total radiation intensity for different methods of excitation. The results are supported by experimental data. A.

535.371

4670. Dependence of the intensity of luminescence of ZnO and ZnSZn on the intensity of excitation. VERGUNAS, F. T. AND GAVRILOV, F. F. *J. Exp. Theor. Phys., USSR*, **18**, 873–7 (*Oct.*, 1948) *In Russian.*—The thermal extinction of the spontaneous afterglow of ZnO and ZnSZn is described by the formula $I = I_0/(1 + Ce^{-v/kT})$, where the coefficient C in both cases depends on the intensity of the excitation, increasing when the latter decreases. This produces at high temps. a departure from linearity in the relation between intensity of the luminescence and of the excitation, respectively. At low temps., prior to the extinction, the *I–E* curve is linear, and satisfactorily represented by the empirical equation

$$I_i = E_i(1 + Ce^{-v/kT})[1 + (C/E_i^k)e^{-v/kT}]^{-1}$$

which fits experimental curves obtained with ZnO and ZnSZn at various temps. A.

535.371

4671. Quenching of phosphorescence [by infra red]. BECKER, A. AND BECKER, F. *Ann. Phys., Lpz.*, **43** (*No.* 8) 598–606 (1943) *In German.*—Both α-rays and pressure lead to an enhancement of i.r. quenching of Cu-activated Zns and ZnS.CdS phosphors as well as to a decrease of luminosity. This effect is appreciably greater with pressure distortion than with α-rays. With Ag-activated phosphors, however, α-rays only are effective. J. E.

535.371

4672. Luminescence quenching and particle size in pressure-destroyed ZnS phosphors. WECKER, F. *Ann. Phys., Lpz.*, **43** (*No.* 8) 607–15 (1943) *In German.*—The decrease of luminescence after pressure in a hydraulic press has been shown to be principally due to distortion of the ZnS crystals rather than increased scattering of the exciting light through decrease of particle size and development of cracks. The quenching effect of distortion is spread throughout the whole crystal. It is claimed that there is also a slight shift of the max. emission wavelength to the red. J. E.

535.

4673. Analysis of the fluorescence bands of uranyl salts. PANT, D. D. *Proc. Indian Ac Sci. A*, **22**, 110–21 (*Aug.*, 1945).—From some di experimental evidence, it is concluded that the en fluorescence spectrum of the uranyl salts arises of a transition from a single excited state (designa $^1\Pi g$) to the several vibrational states of two el ground levels (designated $^1\Sigma g$ and X) and that $^1\Pi g \rightarrow {}^1\Sigma g$ transition is much less favoured than $^1\Pi g$–X transition. The ν_1 and ν_2 frequencies tak part in the transition agree with those observed in Raman and infrared spectra; ν_1 is, however, v much more prominent. The vibrational struct of the $^1\Pi g$–$^1\Sigma g$ transition resembles that of a bidden transition, while the structure of the othe that of an allowed one.

535.

4674. Some studies in the spectra of single ura halides and other uranyl salts. PANT, D. D. *P Indian Acad. Sci. A*, **22**, 95–108 (*Aug.*, 1945).

535.

4675. A new absorption band in alkali ha phosphors activated by thallium. FIALKOVSKA O. V. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 1) 49 (1948) *In Russian.*—The addition of TlCl to I crystals leads to an absorption band at 2 475 Å wh is due to TlCl and increases with its concentrati and also to a new band at 2 730 Å which is detectable at 0·05 mol.% TlCl even in 5·0 mm la and which is constant in intensity from 0· 5 mol.% TlCl. This band, observed using 15 exposures with a H lamp and a Leiss spectrogra is insensitive to temp., shifting only 100 Å to the at 500° C. The band is almost absent in polycrystal samples. In measurements with a Beckmann spec photometer which requires a much reduced expo of the sample to u.v. radiation the band is gre reduced. It is suggested that electrons expelled general u.v. light, as in the production of *F*-cen in pure KCl, are trapped by the Tl^+ ions and Tl atoms are responsible for the new band. polycrystalline materials, surface irregularities c pete for the electrons and less Tl atoms are forn The band at 3 000 Å in the KBr + TlBr syste analogous. D. H

535.3

4676. Raman spectra of ketones and intermolec forces. GOUBEAU, J. AND HEERDT, R. *Naturw* **35** (*No.* 3) 93 (1948) *In German.*—Raman spectr acetone and other ketones have been measure admixture with *n*-C_8H_{18}, *iso*-C_8H_{18}, *cyclo*hex CCl_4, $CHCl_3$, H_2O, CH_3OH and $N(C_2H_5)_3$. effects of association of acetone on the locatio frequencies and frequency shifts are discussed relation to polar character of the solvent. W.

535.375.5 : 5

4677. Raman spectra of the second order in crys I. Calcite. KRISHNAN, R. S. *Proc. Indian Acad. A*, **22**, 182–93 (*Sept.*, 1945).—The first-order Ra spectrum of calcite, using the 2 536·5 Å mer resonance radiation, consists of 5 lines, the frequ shifts and widths of which have been accura measured. The observed second-order Raman

also have been assigned as some of the octaves and allowed combinations of the fundamental frequencies of vibration of the calcite lattice. A.

535.375.5 : 548.7

4678. Raman spectra of the second order in crystals. II. Gypsum. KRISHNAN, R. S. *Proc. Indian Acad. Sci. A*, **22**, 274–83 (*Oct.*, 1945).—Of the 34 Raman lines observed when gypsum is excited using Hg resonance radiation, 10 belong to the lattice spectrum, 14 to the sulphate ion, and 10 to the water of crystallization. The 14 Raman lines of the sulphate ion are divided into 2 classes, 9 being attributed to fundamental vibrations, and the remainder to octaves and combinations of fundamental frequencies. The similarity of the bands assigned to water of crystallization to the Raman bands of ordinary water and ice suggests that the water molecules in gypsum are concentrated in separate sheets parallel to the cleavage face and are only loosely linked up with other ions. W. R. A.

535.375.5 : 548.7

4679. Calculation of the infra-red active and Raman inactive frequencies of α-quartz. SAKSENA, B. D. *Proc. Indian Acad. Sci. A*, **22**, 379–82 (*Dec.*, 1945).—4 of the infrared active and Raman inactive frequencies of α-quartz have been calculated and 3 of these agree closely with the observed values. W. R. A.

535.375.5 : 548.7

4680. The vibration spectra of the alkali halides. KRISHNAN, R. S. AND NARAYANAN, P. S. *Proc. Indian Acad. Sci. A*, **28**, 296–306 (*Nov.*, 1948).—The Raman spectra of alkali halides are discussed in the light of Raman's theory [Abstr. 1877 (1944)] and experimental data for KBr are presented. The main frequencies are 84, 126, 146, 170 and 216 cm^{-1}. A. J. C. W.

535.375.5 : 548.7

4681. Raman spectra of ammonium chloride and bromide. COUTURE, L. AND MATHIEU, J.-P. *Proc. Indian Acad. Sci. A*, **28**, 401–8 (*Nov.*, 1948) *In French.*—The polarization of Raman displacements of monocrystalline cubes of NH_4Cl and NH_4Br has been measured with different orientations. The data have been used to assign the chief lines to types of oscillation and lead to the conclusions that the crystals have O_h or T_h symmetry and the NH_4^+ ions have C_{3v} or C_3 symmetry. W. R. A.

535.375.5 : 548.7

4682. The α–β transformation in quartz. NARAYANASWAMY, P. K. *Proc. Indian Acad. Sci. A*, **28**, 417–22 (*Nov.*, 1948).—By the use of a thin (2 mm) plate of quartz it has been possible to avoid the usual fracture of the crystal at the α–β transition (~ 575°C) and observe the Raman spectrum of β-quartz. The Raman frequencies decrease by 5–25 cm^{-1} on heating from 27° to 550°, and the widths of the lines increase by similar amounts. The lines 207, 357, 1 228 and (probably) 1 083 cm^{-1} disappear above 575°. The 207-line broadens by more than 60 cm^{-1} before fading out. Lines 207, 357, 466 and 1 083 were classified as "symmetric" by Saxena [Abstr. 2985 (1940)] and 1 228 as "degenerate"; 466 does not disappear. A. J. C. W.

535.375.5 : 548.7

4683. Photometry of Raman spectra of crystals. NARAYAN, P. S. *Proc. Indian Acad. Sci. A*, **28**, 463–8 (*Nov.*, 1948).—Using the u.v. Spekker photometer the relative intensities of Stokes and anti-Stokes Raman lines of calcite, quartz, barytes and $NH_4H_2PO_4$ (excited by Hg 2 536 Å) have been found to be ∝ emission frequency)^4. W. R. A.

535.375.5 : 548.7

4684. Raman spectrum of ammonium di-hydrogen phosphate. NARAYAN, P. S. *Proc. Indian Acad. Sci. A*, **28**, 469–74 (*Nov.*, 1948).—The Raman spectrum of $NH_4H_2PO_4$, excited by Hg 2 536 Å, comprises 4 lattice lines, 8 due to internal oscillations of the PO_4 group, and 8 due to NH_4 groups. The continuous distribution of intensity in the lattice spectrum suggests the existence of hindered rotation of the NH_4 and PO_4 groups and the splitting of some of the degenerate lines of both these groups may be due to the strong influence of H-bonds. W. R. A.

535.375.5 : 548.7

4685. Raman spectra of sodium and potassium tartrates. PADMANABHAN, V. M. *Proc. Indian Acad. Sci. A*, **28**, 485–93 (*Nov.*, 1948).—Raman spectra of single crystals of Na and K tartrates, excited by Hg 2 536 Å, have been obtained and show many lines hitherto unrecorded. Tentative assignments have been made to displacements as lattice spectrum frequencies, frequencies of the tartrate ion, and frequencies of H_2O. W. R. A.

535.375.5 : 548.7

4686. Raman spectrum of ethylene diamine tartrate. PADMANABHAN, V. M. *Proc. Indian Acad. Sci. A*, **28**, 494–9 (*Nov.*, 1948).—35 Raman displacements are recorded for ethylene diamine tartrate single crystal excited by Hg 4 358 and 4 047 Å. Many lines are markedly affected in intensity by varying the orientation of the crystal. Lines due to tartrate have been identified by comparison with the spectrum of Na tartrate. W. R. A.

535.375.5 : 548.7

4687. Raman spectrum of sodium chlorate. KUMARI, C. S. *Proc. Indian Acad. Sci. A*, **28**, 500–5 (*Nov.*, 1948).—A single crystal of $NaClO_3$, excited by Hg 2 536 Å, gives 15 Raman displacements, 9 of which are due to internal oscillations and 6 due to lattice oscillations. W. R. A.

535.375.5 : 548.7

4688. The influence of the cation on the intensity of the Raman spectra of salt powders. THEIMER, O. *Proc. Indian Acad. Sci. A*, **28**, 505–18 (*Nov.*, 1948) *In German.*—The variation of polarizability with the normal co-ordinates of molecular vibration has been examined theoretically by a wave-mechanical treatment. W. R. A.

535.375.5 : 548.7

Raman spectrum of the diamond lattice. *See Abstr.* 5115

535.376 : 537.542

4689. Decay times of scintillations. COLLINS, G. B. Letter in *Phys. Rev.*, **74**, 1543–4 (*Nov.* 15, 1948).—Quantitative values for the decay times of phenolic phosphors used in scintillation counters were obtained

by attaching the phosphor under investigation to the envelope of a selected 931-A photo-multiplier tube, the output of which was connected directly to the deflecting plates of a micro-oscillograph (sensitivity 2 V per line width). The resulting estimated decay constants ($\times 10^8$) are naphthalene $5{\cdot}7 \pm 0{\cdot}5$, anthracene $1{\cdot}3 \pm 0{\cdot}2$, and phenanthrene $0{\cdot}9 \pm 0{\cdot}2$ sec. Similar results were obtained with commercial and purified naphthalene, and also with naphthalene and anthracene at both room and near liquid N temps. Trace diagrams are reproduced; they show steep, short steps, and slowly rising larger deflections, with evidence of ringing on the enlargements. J. G.

535.39 : 535.417

4690. Optical properties of solid thin films. TOLANSKY, S. *Nature, Lond.*, **163,** 885–6 (*June* 4, 1949).—Brief report of an international colloquium held at Marseilles (April, 1949). The papers fell into 4 groups: (*a*) determination of optical properties and thickness of thin metal or dielectric films; (*b*) the principles and applications of multiple-beam interferometry; (*c*) preparation of interferometric wavelength filters and discussion of their characteristics; (*d*) improving the optical properties of surfaces by deposition of multiple films with alternate low and high refractive indices.

535.417

4691. Multiple-beam interferometry: intensity distribution in the reflected system. HOLDEN, J. *Proc. Phys. Soc., Lond. B,* **62,** 405–17 (*July*, 1949).—The intensity distribution within the reflected fringe system from a multiple-beam interferometer employing silvered reflecting surfaces is discussed in its dependence upon the reflectivities and phase conditions at the reflecting surfaces. Using the Fizeau fringes of equal thickness localized on the zero-order Feussner surface, the reflected intensity distribution is examined experimentally as the reflection coefficients of the interferometer surfaces vary between 4% and 90%. In the range of low reflectivities, when the silverings used showed marked colours, the changes in the reflected system lead to the measurement of a phase quantity related to the optical constants of the Ag in the form of the thin film. Also in this range, the reflected fringes have a symmetrical form which is of use in the examination of sources of low intensity. In the range of high reflectivities, the conditions for the use of the reflected fringes in topographical investigation are discussed. The findings apply to fringes of equal chromatic order as well as to Fizeau fringes in reflection. A.

535.42

4692. On the intrinsic form of the transformation for inverse interference. TORALDO DI FRANCIA, G. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5,** 48–50 (*July–Aug.*, 1948) *In Italian.*—A vector form of the transformation is given, which constitutes an extension to the case of diffraction of the methods used by Sommerfeld and Runge in geometrical optics. L. P.

535.42

4693. On the imagery of optical gratings. MENZEL, E. AND MENZEL, C. *Optik*, **4** (*No.* 1) 22–36 (1948) *In German.*—A coarse amplitude grating was made by winding 17 turns of phosphor bronze wire (0·15 m dia.) on a metal frame. A phase grating was ma by pressing this wire frame against a thin layer half-dry acetate varnish on glass. These obje were used to study experimentally the ima obtained when using stops to suppress vari groups of spectra. In this way a Fourier type theory of image-formation has been checked in cases of symmetrical and asymmetrical suppressi of spectra, and out-of-focus images. For pha gratings the out-of-focus, knife-edge and pha contrast techniques were studied. A number photographs is given showing good agreement w the theoretical intensity curves. H. H. H

535

4694. On the theory of diffraction by an apert in an infinite plane screen. II. LEVINE, H. A SCHWINGER, J. *Phys. Rev.*, **75,** 1423–32 (*May* 1949).—See Abstr. 1842 (1949). The diffraction a scalar plane wave by an aperture in an infinite pla screen is examined theoretically. The wave functi at an arbitrary point of space is expressed in terms the discontinuity in its normal derivative at the scre where the boundary condition is that of vanishi wave function. An integral equation for the d continuity in normal derivative (or the resid function which measures its deviation from the simp distribution appropriate to a completely infin screen) is the result of applying the boundary c dition to the space wave function. Utilizing integral equation (whose solution is generally obtainable), the diffracted spherical wave amplitu at large distances from the aperture is cast into form which is stationary with respect to sm variations (relative to the correct values) of residual functions arising from a pair of incid waves. An homogeneous expression for the amp tude is exhibited wherein the part independent of residual functions defines a Kirchhoff approximati The connection with another stationary form of amplitude, involving a pair of aperture wave functio is examined. A variational expression for the pla wave transmission cross-section of the aperture based on the amplitude observed in the direction incidence. The variational formulation is appli for a wave incident normally on a circular apertu By comparison with the exact results available this problem, it appears that use of simple resid functions in the variational formulation yie approximate, yet accurate expressions for diffracted amplitude and transmission cross-secti over a wide range of frequencies.

535.

4695. On the diffraction of light. KOSSEL, *Z. Naturforsch.*, **3a,** 496–500 (*Aug.–Nov.*, 1948) *German.*—A simple diffraction phenomenon whi can be demonstrated to a large audience is discusse It is obtained by means of a circular glass disc grou on a lathe with coarse emery paper, so that irregular system of rings is produced. The phen menon consists in a luminous zone confined to small acute angle between two diameters, whi appears as a luminous rod pointing to the sour and visible by transmitted or reflected light. It often seen in reflection on a freshly turned me

surface. The phenomenon is closely investigated and related to well-known diffraction theories. H. MO.

535.42

4696. On the diffraction phenomena around the shadows projected by objects in direct sunlight. KATALINIĆ, M. AND MARKOVIĆ, B. *Ann. Fac. Phil. Univ. Skopje (Sect. Sci. Nat.)* **1**, 3–47 (1948) *In Serbian, summaries in Russian (3 pp.) and English (13 pp.).*

535.421

4697. The production of diffraction gratings. I. Development of the ruling art. HARRISON, G. R. *J. Opt. Soc. Amer.*, **39**, 413–26 (*June*, 1949).—An outline is given of the development and present status of mechanically controlled ruling engines. Gratings having notable performance are described, and problems involved in producing on a reflecting surface large numbers of parallel equidistant grooves of constant or controlled form, with position tolerances of one micro-inch or better, are analysed. Distinctive features of the engines of Rowland, Michelson, Gale, Anderson, Babcock, Siegbahn and others are discussed. It is pointed out that the low productivity of many ruling engines in the past should not discourage present-day experimenters, as improved surfaces for ruling, superior ruling tools, alloys less susceptible to wear, warpage, creep and fatigue, better methods of lubrication and servo-mechanisms capable of making a ruling engine self-correcting, are all now available. Much can be learned by studying the strong points and weaknesses of previous engine designs. A current trend in the use of gratings appears to be away from the concave and toward the plane form. Succeeding papers will deal with a suggested method for obtaining improved gratings having high resolving power, and with the modification and testing of a 14 in ruling engine. A.

535.421

4698. On the light diffracted by a large number of apertures distributed at random on an opaque screen. TORALDO DI FRANCIA, G. *Atti Accad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)*, **4**, 730–5 (*June*, 1948) *In Italian.*—A mathematical solution of this problem is given in Kirchhoff's approximation, based on an asymptotic probability law holding for the random walk problem. This applies: (*a*) In the case when some statistical interdependence exists between the positions of the apertures; (*b*) when the source of light is small, and there are privileged directions in the diffraction figure. L. P.

535.43 : 548.0

The influence of optical activity on light scattering in quartz. *See Abstr.* 5096

535.43 : 771.351

Nephelometer for photographic lenses. *See Abstr.* 5182

535.434

4699. The scattering of light and its applications to chemistry. OSTER, G. *Chem. Rev.*, **43**, 319–65 (*Oct.*, 1948).—A review of light scattering by independent and non-independent particles. The differences in behaviour of small isotropic and anisotropic particles are discussed. Scattering by large spheres, by metallic particles, by large particles with relative index of refraction near unity, and depolarization by large particles are considered. The behaviour of pure liquids, non-ideal solutions, liquids at the critical temp., and of interfaces is reviewed. The fine structure of the Rayleigh line is briefly discussed. W. R. A.

535.435

4700. On the scattering of polarized light by liquid crystals of the nematic type. CHATELAIN, P. *Acta Cryst.*, **1**, 315–23 (*Dec.*, 1948) *In French.*—After references to earlier work, details are given of the scattering of plane polarized Na light by mechanically orientated preparations of azoxyanisol and *p*-azoxyphenetol in the liquid crystal state. From the optical point of view the orientations obtained are equivalent to crystalline plates cut $\parallel$ and $\perp$ to the optical axis. The apparatus and the photometric method of analysis are described. The scattering angle in the crystal is varied from 0 to 50° and the effect of temp. on it discussed: the scattering angle in air is independent of temp. Results are tabulated and analysed: they show that the most intense scattered radiation is polarized at right angles to the vibration direction of the incident beam and is more intense the smaller the angle of scattering. For a given temp., the relation $\xi = k/(\sin\phi)^{1\cdot6}$ holds where ξ is the scattered intensity, k is a constant and ϕ is the scattering angle and shows that scattering is due to large particles; a comparison of scattering in forward and backward directions indicates that the dimensions of these particles are about $0{\cdot}2\,\mu$. The *p*-azoxyphenetol gives a scattered intensity $\frac{3}{4}$ of that for azoxyanisol, all other things being equal. The principle of reciprocity for a statistically anisotropic medium as formulated by Perrin applies and a depolarization factor greater than unity exists. See Abstr. 1151 (1912); 1850 (1925); 2585 (1926); 670 (1927); 3353 (1930); 4973 (1934); 981, 5378 (1936); 4819 (1937); 1623, 2009 (1938); 49, 1464 (1939); 2098 (1946). H. G. J.

535.435

4701. Molecular diffusion of light by dilute solutions. ROUSSET, A. AND LOCHET, R. *Rev. Sci., Paris*, **86**, 291–4 (*March* 1 *and* 15, 1949) *In French.*—A critical survey of recent theoretical developments. L. P.

535.436 : 551.593.55

Influence of diffraction on the brightness of the twilight sky. *See Abstr.* 5168–9

535.51

4702. Performance and testing of polarizing prisms. ARCHARD, J. F. *J. Sci. Instrum. Phys. Ind.*, **26**, 188–92 (*June*, 1949).—The effect on the polarization of the transmitted light of reflections at the film surface in polarizing prisms is discussed. It is shown that for the Glan type of prism (Glan–Thompson and Glan–Foucault) no depolarization effects occur when rays incident and emergent within the effective polarizing aperture are considered. The effects of various errors in construction on the performance of the prism are considered, and various optical methods of testing the prism are outlined. A.

535.554 : 548.0

The photoelastic properties of ionic crystals. *See Abstr.* 5098

535.563

4703. Action of a magnetic field at low temperatures on the natural rotatory power of nickel sulphate hexahydrate. LEVY, M. *C.R. Acad. Sci., Paris*, **227**, 1218–20 (*Dec.* 8, 1948) *In French.*—Rotatory powers of crystalline nickel sulphate hexahydrate for the wavelengths of the Hg yellow, green and violet lines are recorded at temps. ranging from 1·36 to 294·1°K. The variations are in accordance with the temp. displacements of the absorption bands concerned. Effects of longitudinal and transverse magnetic fields at these temps. are also recorded, the rotatory powers being increased by the magnetic field. C. B. A.

535.64

4704. Comparison of colour systems with respect to uniform visual spacing. BURNHAM, R. W. *J. Opt. Soc. Amer.*, **39**, 387–92 (*May*, 1949).

535.642

4705. Colour measurement. EVANS, E. B., MCCUE, C. F. AND WOODROW, W. A. *J. Inst. Petrol.*, **35**, 221–44 (*April*, 1949).—After reviewing some of the fundamental principles of colour vision and colour measurement, the report deals with the specification of colour by means of the tristimulus equation. This leads to a consideration of the unit trichromatic equation, the chromaticity diagram, and finally the *X, Y, Z* equation of the C.I.E. System. Methods of colour measurement used in the petroleum and allied industries are then discussed, and some details are given of attempts to correlate results obtained on different instruments. The report ends with a glossary of terms. A.

535.65

4706. Colorimetry by abridged spectrophotometry. HARDY, A. C. AND YOUNG, F. M. *J. Opt. Soc. Amer.*, **39**, 460–2 (*June*, 1949).—It seems to be generally conceded that the results obtained with a photoelectric colorimeter are significant only when the spectral characteristics of the sample and standard are similar. When this is the case, the selected ordinate method of integrating spectrophotometric data can be greatly abridged, a single selected ordinate being adequate under many circumstances. This means that an abridged spectrophotometer can be used for the dual purpose of production control and, when necessary, the determination of tristimulus values. A.

535.65

4707. Laboratory-built photoelectric colorimeter and fluorimeter. MCGILLIVRAY, W. A. *N.Z. J. Sci. Tech. B*, **29**, 317–24 (*May*, 1948).—Describes a colorimeter for chemical use (e.g. estimation of vitamin A) in which a rectifier photocell is used. An attachment for fluorimetric estimation is provided. J. W. T. W.

535.73/.75

4708. Measurement of the influence of local adaptation on colour matching. MACADAM, D. L. *J. Opt. Soc. Amer.*, **39**, 454–9 (*June*, 1949).

535.8

4709. Optical instruments shown at the Physical Society's Exhibition. HOUGHTON, J. L. *J. Sci. Instrum. Phys. Ind.*, **26**, 178–80 (*June*, 1949).

535.8

4710. The computation of two-lens inverting systems. FRANKE, G. *Optik*, **4** (*No.* 1) 37–50 (1948) *In Germa*—A treatment, using Berck's notation, of the Sei errors of two spherically corrected unaplana achromats, separated such as to give a desired fo of astigmatic correction. The system as a whole corrected for coma, has parallel light between two elements, and works at a small magnificati Tables are given from which one can find all required curvatures and the dispersion of the seco glass, when given the dispersion of the first and two refractive indices. H. H. H

535.8 : 621.383 : 621.385.8

4711. The brightness intensifier. MORTON, G. RUEDY, J. E. AND KRIEGER, G. L. *RCA Rev.*, 419–32 (*Sept.*, 1948).—By combinations of opti and electronic means it is possible to reproduce image of a scene in greater brightness than that of original. A general discussion is given of the possi improvement in seeing under low light conditions the use of brightness intensifiers, and the fundamen limit to such improvement is shown to be the statisti fluctuation in the number of photons entering the e When the object viewed is a small luminous area point of light, a gain in brightness may be obtained optical means alone and the electronic intensificati adds no further useful information. When a consta large angular field of view must be maintained, optical system consisting of an objective of la diameter forming an enlarged image on the prima photosensitive screen of a brightness intensifier c be used to advantage, since the brightness intensif permits passing along to the eye the gain in see resulting from the greater photon gathering power the large objective. An interesting application of image intensifier would be in rendering more formation available from medical fluorescent X- screens. It is shown that the information available limited by the randomness in the X-ray beam itse and the only significant gains would be in ease viewing or in a more convenient size of the fi image.

535.8 : 621.385.8

4712. Microscopy by reconstructed wave-fron GABOR, D. *Proc. Roy. Soc. A*, **197**, 454–87 (*July* 1949).—Discusses a new two-step method of opti imagery. [See Abstr. 2802 (1948)]. In a first st the object is illuminated with a coherent monochr matic wave, and the diffraction pattern resulting fr the interference of the coherent secondary wa issuing from the object with the strong, cohere background is recorded on a photographic pla If this plate, suitably processed, is replaced in original position and illuminated with the cohere background alone, an image of the object will appe behind it, in the original position. This proc reconstructs the coherent secondary wave, toget with an equally strong "twin wave" which has same amplitude, but opposite phase shifts relative the background. The illuminating wave itself can used for producing the coherent background. T simplest case is illumination by a point source. this case the two twin waves are shown to correspo to two "twin objects," one of which is the origin the other its mirror image with respect to the illumi ting centre. A physical aperture can be used a

point source, or the image of an aperture produced by a condenser system. If this system has aberrations, such as astigmatism or spherical aberration, the twin image will be no longer sharp but will appear blurred, as if viewed through a system with twice the aberrations of the condenser. In either case the correct image of the object can be effectively isolated from its twin, and separately observed. Three-dimensional objects can be reconstructed, as well as two-dimensional. The wave used in the reconstruction need not be the original: it can be, for example, a light-optical imitation of the electron wave with which the diffraction diagram was taken. Thus the idea of Bragg's "X-ray microscope" may be extended to arbitrary objects, and the new method used for improvements in electron microscopy. The apparatus will consist of two parts, an electronic device in which a diffraction pattern is taken with electrons diverging from a fine focus, and an optical synthetizer, which imitates the essential data of the electronic device on a much enlarged scale. The theory of the analysis-synthesis cycle is developed, with a discussion of the impurities arising in the reconstruction, and their avoidance. The limitations of the new method are due chiefly to the small intensities which are available in coherent beams, but it appears feasible to achieve a resolution limit of 1 Å. A.

535.81

4713. Optics of solids. I. Optical properties of solids. Joos, G. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 163–84 (1948) *In German.*—Refraction of light by solids, especially glasses, was investigated, and Kordes found a relation between the molecular refractivity and the chemical composition, and also an additive affect on mixing with organic and other substances. Other properties reviewed include: double refraction, reflection of light from non-conductors, total reflection, the scattering of light by solids and Raman effect, absorption of light especially u.v. in solids and glasses, line and band absorption for solids, including the oxides of alkali metals and several hydrides, and absorption in mixed crystals. The theoretical treatment uses recent ideas on the band theory of solids. Some experiments on vacuum-evaporated thin metal films are described. C. A. H.

535.82

4714. An achromatic microscope objective for use with ultra-violet light. Johnson, B. K. *J. Sci. Instrum. Phys. Ind.*, **26**, 193–4 (*June*, 1949).—A compound Lister-type microscope lens is described having an N.A. of 0·27 which, when focused in visible green light, is simultaneously in focus in u.v. light. Means are described for obtaining absorption curves of biological specimens in u.v. light with a view determining their chemical composition. A.

535.822.9

4715. The phase-contrast incident-light microscope. Cuckow, F. W. *J. Iron Steel Inst.*, **161**, 1–10 (*Jan.*, 1949).—A review is given of experiments in the comparative microscopy of metals leading to the conclusion that new information can be gained from a knowledge of the various levels existing in the surface of the prepared metallurgical specimen. The means already available for the assessment of these levels are discussed. A new instrument for this work, a phase-contrast incident-light microscope, is described. A comparative microscope is also described in which a single field of view is divided into two parts, one of which is seen under phase-contrast conditions and the other under normal microscopical conditions. The dividing line can be moved across the field of view. Photomicrographs from the instrument are shown. A.

535.862

4716. Transmission of light from diffuse sources by periscope tubes. Bundy, F. P. and Strong, H. M. *J. Opt. Soc. Amer.*, **39**, 393–401 (*May*, 1949).—Treats in detail the problem of transmitting light from a diffuse source, such as a flame, to a place some distance away for the purpose of making spectroscopic measurements. The particular cases which have been analysed are: the simple uniform tube, the simple tapered tube, the uniform tube containing one lens placed at its focal distance from the light source, the uniform tube with one lens of focal length equal to $\frac{1}{4}$ the length of the tube placed at the midpoint of the tube, the uniform tube with a series of lenses spaced at intervals of twice their focal length, and uniform simple tubes with reflecting walls. In each case expressions for the total amount of light transmitted have been derived and the relative strength of the contribution from different zones of the source has been investigated. The greater part of the work is theoretical but most of the conclusions have been tested experimentally. It is found that a tube with reflecting walls and no lenses gives the greatest amount of transmitted light. This light emerges from the output end of the tube nearly parallel to the axis but is disordered so that the formation of sharp images is impossible. However, this is usually satisfactory in transmitting light to instruments such as interferometers and spectrographs when sharp images are not necessary. A tube fitted with lenses spaced 2 focal lengths apart gives efficient transmission of light as well as formation of sharp images of the source at intervals of 4 focal lengths along the tube. Thus if it is desired to use light from specific parts of the diffuse source the "2F" lens system should be used even though it transmits less light than the open tubes with reflecting walls. A.

535.89

4717. Use of spectra of compressed rare gases as source of continuous emission. Weniger, C. and Herman, L. *C.R. Acad. Sci., Paris*, **227**, 1217–18 (*Dec.* 8, 1948) *In French.*—A small Pyrex discharge tube filled with Kr to a pressure of 15 kg/cm² serves as a steady source of continuum. Operating on 800 V a.c. at < 3 W it is bluish and has a high colour temp.; its emission spectrum is compared with that of a black body at 7 200°K. A. G. G.

HEAT 536

536.2.08

4718. The thermal conductivity of organic materials near the melting point. Read, J. H. and Lloyd, D. M. G. *Trans. Faraday Soc.*, **44**, 721–9 (*Sept.*,

1948).—An apparatus has been constructed for the measurement of thermal conductivity near the m.p. of organic solids, and has been calibrated with liquids for which data are already available. Repeated measurements have revealed an abrupt discontinuity in the thermal conductivity of TNT at the m.p. and suggest that a min. in conductivity exists under the conditions of experiment. The interpretation of these results is briefly discussed. A.

536.21

4719. Thermodynamics of solids. IV. Heat conduction in solids. MEISSNER, W. AND SCHUBERT, G. U. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 212–20 (1947) *In German.*—A modification of the Forbes bar method for the thermal conductivity, K, of a metal has been described, and the comparative principle has been applied to poor conductors in the form of plates. Fritz and his collaborators have investigated the values of K and the specific heat for many varieties of coal and coke, and have found a smooth variation between the values of K and the true density. Plastics have been investigated by Gottwald utilizing the measurement of temp. distribution, before equilibrium has been attained, in a steam calorimeter. Theoretical work has included the formulation of a general thermodynamics of irreversible processes, special solutions of the general equation of heat conduction, an extension of a theory due to Maxwell to include the conduction of heat in porous solids, and the development of a theory of heat flow in porous solids with various moisture contents. C. A. H.

536.212.2 : 536.48

4720. Some measurements of heat flow along technical materials in the region 4° to 20°K. WILKINSON, K. R. AND WILKS, J. *J. Sci. Instrum. Phys. Ind.*, **26,** 19–20 (*Jan.*, 1949).—Measurements have been made of the heat flow along specimens of various materials placed with one end at temps. varying from 14° to 20°K and the other at a temp. of 4·2°K. Results are given for nickel-silver, cupro-nickel, stainless steel, copper and glass. From these results the thermal conductivities of the materials at temps. between 10°–20° are derived. A.

536.212.3 : 666

4721. Interpretation of the thermal conductivity of glasses. KITTEL, C. *Phys. Rev.*, **75,** 972–4 (*March* 15, 1949).—The thermal conductivity of glasses decreases with decreasing temp., while the conductivity of crystalline substances increases with decreasing temp. The behaviour of glasses is interpreted in terms of an approximately constant free path for the lattice phonons, so that the conductivity decreases roughly with the specific heat. The value of the phonon mean free path at room temp. is of the order of magnitude of the scale of the disorder in the structure of glasses as determined from X-ray evidence —that is, of the order of 7 Å. This is about the size of the unit cell of the crystalline forms of silica. A.

536.22

4722. Heat transfer characteristics of fluidized beds. MICKLEY, H. S. AND TRILLING, C. A. *Industr. Engng Chem.*, **41,** 1135–47 (*June*, 1949).

536.24

4723. Heat transfer measurements on mercu ELSER, K. *Schweiz. Arch. angew. Wiss. Tech.*, 330–6 (*Nov.*, 1948) *In German.*—The apparatus u for measurements on the turbulent flow of Hg in t circular steel tubes and one Fe, of different diamet and wall thicknesses, is described. Observati were made over the range $0{\cdot}373$–$1{\cdot}889 \times 10^5$ for (Reynolds number) and $0{\cdot}1782$–$0{\cdot}02419$ for (Prandtl number). The results for N_u (Nus number) are compared with the theoretical relati of Kraussold, Prandtl–Bosch, von Kármán Hofmann, and the experimental results of Stynkowit and Ssemenowker. S.

536.

4724. Heat transfer with surface boiling. KNOWI J. W. *Canad. J. Res. A*, **26,** 268–78 (*July*, 1948) Account of experiments to investigate heat trans from solid surfaces to flowing water. Bulk temp cooling water below b.p., and surface temp. of h transfer tube up to about 100°c above b.p. Wa velocity up to 10 ft/sec^{-1} and heat fluxes up 720 W.cm^{-2}. With surface boiling the non-dimensi less heat transfer constant in the Dittus and Boe formula increases to 4× that without surface boili R. E

536.

4725. Experimental investigation of heat excha between two immiscible liquids. YABLONSKI, V. AND YABLONSKAYA, V. P. *Dokl. Akad. Na SSSR*, **59** (*No.* 9) 1575–7 (1948) *In Russian.*—H exchange between water and oil products (para oil, spindle oil, motor-car lubricating oil, naval oil) has been measured. At the water-oil interf (1) velocities of either liquid are different from ze (2) temps. of both liquids are equal, (3) due to sm viscosity of water, the inner friction forces can neglected. These assumptions lead to the empir equation $\overline{Nu} = 1{\cdot}25(\overline{Gr} \times \overline{Pr^2})^{0{\cdot}250}$ where the Nuss Grashof and Prandtl parameters are calculated the given temp. of the interface. These temps. calculated (not measured) from the equat

$$T_{\text{interf.}} = \frac{T_2 + \phi^{0{\cdot}2} T_1}{1 + \phi^{0{\cdot}2}}$$

where T_1 is the temp. of water, T_2 that of the product, and $\phi = (\lambda_1^2\beta_1 C_1^2\gamma_1^2)/(\lambda_2^2\beta_2 C_2^2\gamma_2^2)$ where λ the coeff. of thermal conductivity, β—coefficient volume expansion, C—heat capacity, γ—spec gravity. T_1 can be taken instead of $T_{\text{interf.}}$ with causing an error $> 5\%$. H

536.33.08 : 535.23

Classification and factors of merit for radia detectors. *See Abstr.* 4594–5

536.4.031 : 532.

4726. Viscosity and density in the supercoo liquid state. DODD, C. AND HU, PAK MI. *Proc. Ph Soc., Lond. B*, **62,** 454–60 (*July*, 1949).—In orde determine whether any structural change takes pl when a liquid is supercooled, measurements h been made on the viscosity of pure phenyl et which by its melting point (26·85°c) is suitable accurate work. It has been found that in both ordinary and the supercooled state the liquid ob

a formula of the type $\eta = A \exp(b/T)$, but that the value of b in the supercooled state, which was investigated down to 17°C below the m.p., is significantly > the value of b for liquid above the m.p. It is shown that an accurate value for the m.p. can be obtained from viscosity measurements without the liquid ever becoming solid. The temp. coeff. of density shows no detectable change in passing through the m.p. A.

536.41 : 533.21

The influence of velocity in adiabatic compression. *See Abstr.* 4550

536.421.4

4727. Some experiments in the freezing of water. SMITH-JOHANNSEN, R. *Science*, **108**, 652–4 (*Dec.* 10, 1948).—The freezing of H_2O samples supported on cellulose acetate membranes has been investigated. The membranes were stretched across a hole in a Cu plate, with their lower surfaces in contact with a Hg-covered Cu stud in thermal contact with the cooling system, so that the H_2O surface was exposed to the air but with no air-solid interface, below 0°C, in contact with the liquid. The presence of ice was detected by the birefringence produced when polarized light passed through the sample and was reflected at the Hg surface through an analyser to the observer. Various methods of cleaning the surfaces and purifying the H_2O were tried. The temp. at which water freezes, in the absence of foreign nuclei, was found to be close to −20°C, and independent of the rate of cooling, the previous thermal history of the sample, and mechanical vibration. The f.p. was altered by the introduction of different powdered materials, but was not raised to 0°C. As a sublimation nucleus for ice, graphite was ineffective, but, as a freezing nucleus in H_2O, was more effective than AgI. The crystallization temp. of a sample of H_2O in a methyl methacrylate container and irradiated for 30 sec by ultrasonic radiation of 1 Mc/s, was lowered to about −30°C. S. W.

536.421.48 : 551.578.4

4728. Supercooling and crystallization. HEVERLY, J. R. *Trans. Amer. Geophys. Un.*, **30**, 205–10 (*April*, 1949).—The supercooling of H_2O droplets under conditions equivalent to those found in nature has been quantitatively studied, and the temp. at which H_2O vapour in ordinary atmospheric air will crystallize to form snow crystals has been determined. The spontaneous freezing point is presented in a graph as a function of droplet size. Such varied sources as tap water, distilled water, mountain stream water and water condensed from the atmosphere were used. A photomicrograph of formvar replicas of the snow crystals formed is presented, and the size distribution and relative number of the accompanying supercooled water droplets is given as a function of temp. The results of the supercooling and crystallization investigations indicate that the current precipitation theories need modification. A new concept of the initiation of precipitation is presented. A.

536.424

4729. The allotropy of iron and that of helium. BENEDICKS, C. *Rev. Métall.*, **45**, 397–401 (*Oct.*, 1948) *In French.*—Four possible cases of allotropy are discussed with particular reference to a β phase in Fe and the behaviour of He II. In the latter case partial or complete ionization of the He II is suggested as a basis for explaining the extraordinary phenomena peculiar to it. H. P. M.

536.425

4730. Thermodynamics of solids. III. Phase changes in solids. HETTNER, G. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 206–11 (1947) *In German.*—Reference is made to the many methods by which phase changes in solids may be detected and measured, including optical and X-ray methods, measurements of dielectric constant, electrical resistance, contact potentials against a metal, and magnetic and piezoelectric effects, changes in elastic properties, and measurements with dilatometers. Order-disorder transitions in AuCu alloys have been investigated by a thermoelectric method, against Cu electrodes. Reference is made to many investigations into phase changes caused by rotation of the molecule, and to many diverse results on the subject for such substances as FeS, Al_2O_3, TiO_2, silicates and alkalihydro-sulphides and -selenides. C. A. H.

536.46 : 537.566

4731. Ionization flame detectors. CALCOTE, H. F. *Rev. Sci. Instrum.*, **20**, 349–52 (*May*, 1949).—Two new ionization methods of detecting flames are described for use in the measurement of flame speeds. In one the loading characteristics of a high frequency oscillator are utilized by causing the flame to pass through an oscillator tank coil. The second method employs the flame conductivity by placing 2 ring electrodes around the exterior of a combustion tube, and applying a d.c. voltage across them through a large series resistance. The voltage pulse created by either method when the flame passes the detector is used to trigger an electronic chronoscope. Both methods have the distinct advantage over previous methods of flame detection in that the direct measurement of flame speeds can be made without the introduction of electrodes or wires into the combustion tube. The oscillator detector has the additional advantage that the point at which the measurement is made can be varied at will. A.

536.5 : 533.5 : 531.7

4732. Mechanical, thermal and vacuum instruments at the Physical Society's Exhibition. PEACOCK, A. G. *J. Sci. Instrum. Phys. Ind.*, **26**, 180–2 (*June*, 1949).

536.52/.53

4733. Notes on the experimental technique of some physico-chemical measurements between 1 000° and 2 000°C. KITCHENER, J. A. AND BOCKRIS, J. O'M. *Disc. Faraday Soc.* (*No.* 4) 91–100 (1948).—The furnace suited to most studies in this range is of the Mo or W resistance type. The metal, preferably in strip form, is wound on to an alumina refractory tube (micronized zircon is used above 1 800°C) and maintained in a reducing atmosphere. The design and performance of two furnaces suitable for electrical conductivity measurements up to 1 800°C and 2 000°C respectively are described in detail (with constructional diagrams). The measurement of high temps. is discussed; thermocouples are reliable up to 1 600°C,

with an accuracy of ±3° and an optical pyrometer capable of measuring 1 800°C to an accuracy of ±5°C is described. The use of Mo as a refractory is advantageous when freedom from attack at high temps. is required; the construction of "molybdenum ware" by welding in a reducing atmosphere is briefly described. J. O'M. B.

536.53

4734. Laboratory evaluation of a method proposed by Gnam for measuring the temperature of rotating parts. DAHL, A. I. AND FREEZE, P. D. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 601–7 (*Dec.*, 1948).—A description is given of the construction, calibration and performance tests on a small-scale apparatus. Neither slip-rings nor telemetering are required. The measuring system consists of two separate circuits linked magnetically. A nickel-chromel thermocouple in series with the rotor coils of a specially designed convertor forms the rotating circuit, and the stator coils of the convertor connected to an impedance-matching transformer and oscilloscope the stationary circuit. One thermocouple junction is fixed to the rotating part (a 6 in diameter, $\frac{1}{16}$ in thick, disc simulating a turbine wheel) and the other protrudes from a hollow shaft into a furnace. The full-scale application is discussed and several suggestions as to design are made. S. W.

536.531

4735. The use of semi-conducting ceramic glaze for the measurement of temperature. FORREST, J. S. *J. Sci. Instrum. Phys. Ind.*, **26**, 254–5 (*July*, 1949).

536.532

4736. A tuned low-frequency amplifier for use with thermocouples. BROWN, D. A. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 194–7 (*June*, 1949).—A system is described for the detection of very small signals of heat radiation. The output of a suitable thermocouple, receiving radiation "chopped" at 5 c/s, is stepped up by a transformer and applied to an amplifier tuned to the "chopping" frequency. A narrow bandwidth (0·63 c/s) and special design of the first stage of amplification are employed to keep the amplifier noise level low. The equivalent noise input resistance of the system referred to the transformer primary terminals is only 1 or 2 Ω, so that the Johnson noise inherent in the thermocouple resistance normally limits the minimum signal which may be detected. The final amplified signals are rectified by a mechanical switch; this has certain advantages over more conventional electronic circuits. A.

536.532 : 621.315.5 : 621.362

4737. Choice and behaviour of metallic materials for thermo-elements. SCHULZE, A. *Elektrotechnik, Berlin*, **3**, 65–70 (*March*, 1949) *In German.*—Materials are described for thermoelements suitable for average (0–600°), high (1 000–1 200°), and low temps., and also for particular objectives such as the measurement of feeble alternating currents and radiation. Problems arising out of the use of friable substances and from combinations of thermoelements are discussed, and the present position at the highest temps. is reviewed. There are 6 diagrams, and a table of thermoelectric potentials for the materials involved. H. H. HO. (R)

536.62 : 5

Calorimeter for measuring heat loss and producti in animals. *See Abstr.* 5176

536.

4738. Thermodynamics of solids. II. Specific he and heat capacity of solids. CLUSIUS, K. *FIAT Re German Sci.* (1939–46) [*Off. Mil. Govt. German "Physics of Solids, I,"* 193–205 (1947) *In German.* A full review is given. Förster and Tschenk have described a method of measuring both electric resistance and specific heat of metals in the solid a molten states. Measurements have been made many substances of technical importance such wood, synthetic rubber, natural stones and brick and solid carbonaceous fuels. Data for fundamen theoretical interpretation have been obtained fro measurements down to liquid He temperatures such materials as LiF, GeH_4 and deuterium-su stituted compounds. See Abstr. 4742 (1949). C. A.

536.6

4739. Specific heat. HEYBERGER, L. *Indus Plast.*, **2**, 260–7 (1946).—Sp. heat and thermal co ductivity data for a large number of materials (most solids) are tabulated. The sp. heat of mould phenol resins is 0·35. Methods for determini sp. heat are reviewed. B.

536.

4740. Some physical properties of uranium hex fluoride. AMPHLETT, C. B., MULLINGER, L. W. A THOMAS, L. F. *Trans. Faraday Soc.*, **44**, 927– (*Nov.*, 1948).—The purification of UF_6 is describe From 12° to 50° the vapour pressure is given $\log p$ mm $= 10{\cdot}74 - 2\,592/T$ yielding for latent he of sublimation $11{\cdot}82 \pm 0{\cdot}1$ kcal. per mol. a $56{\cdot}7 \pm 0{\cdot}5°$ for sublimation temp. at 760 mm H The vapour obeys the gas laws in this temp. rang Dielectric constant measurements of the vapour ga $\varepsilon = 1{\cdot}0038 \pm 0{\cdot}0001$ at 20° and 760 mm and a to polarization of 30·7 c.c. The vapour absor continuously in the u.v. at room temp. with comple extinction below ~ 3 100 Å. W. R.

536.6

4741. Differential thermal analysis. VOLD, M. *Analyt. Chem.*, **21**, 683–8 (*June*, 1949).—Equatio are derived which make possible the calculation heats of transformation from differential heati curves, independent of external calibrations. T rate of restoration of a thermal steady state after transformation is employed to establish the relati between the differential temperature and the he absorption producing it. Valid results are obtain for such widely divergent processes as the melting stearic acid and the vaporization of water, usi exactly the same rapid and convenient experimen procedure. A fully automatic self-recording diff ential calorimeter is described, and the facto influencing the design finally adopted are discussed.

THERMODYNAMICS 536.7/.8

536.

4742. Thermodynamics of solids. I. Equation state of solids. WIRTZ, K. *FIAT Rev. German S*

939–46) [*Off. Mil. Govt. Germany*] "*Physics of olids, I*," 189–92 (1947) *In German.*—The X-ray ethod of determining the expansion coefficient, in hich the increase in lattice constant with temp. is easured, is described by Straumanis, who applied it various anisotropic substances. BeO has been vestigated up to 1 000°c by this method. Gott ompared X-ray and optical techniques, finding act agreement for Al, but discrepancies of 3% for Br, 9% for KF and 14% for KI, which have been plained by Schottky using the well-known ehlordnungstheorie." A H-displacement method as been used for such substances as chloroform and nzene at low temps., and an interferometric method as been applied to many metals and certain non-etallic elements also at low temps. Reference is ade to the correlation between the expansion efficient and the structure of glasses, a subject of chnical importance. C. A. H.

536.71

4743. Thermodynamic properties of air at high-mperatures. HIRSCHFELDER, J. O. AND MAGEE, J. L. .S. *Atom. Energy Comm.* (*Doc., No. MDDC–590*) 1–49 (*Jan.* 1, 1947).—The approx. properties have een tabulated in 2 sections. The first section is ssentially an extension of the tables of Brinkley, irkwood and Richardson, and has been made to t the published values of Bethe and Fuchs, Kynch, nd Peierls, with only a slight amount of smoothing. the second section, the equation of state has been ut into a form suitable for IBM machine or naracteristic calculations. This involved a con-derable amount of smoothing and some loss of ccuracy, but should serve for studying the qualitative nd semiquantitative features of the hydrodynamics f shocks in air. The authors point out the desir-bility of greater accuracy, and estimate the amount f labour which would be required. In one table a nction is tabulated for determining the temp. when e pressure and density are known, for densities etween 20 and 0·0001 times the normal density of air nd in the temperature range between 1 000 000°K nd 1 000°K. A. M. R.

536.71

4744. Equations of state of elements based on the eneralized Fermi–Thomas theory. FEYNMAN, R. P., ETROPOLIS, N. AND TELLER, E. *Phys. Rev.*, **75**, 61–73 (*May* 15, 1949).—The Fermi–Thomas model as been used to derive the equation of state of natter at high pressures and at various temps. alculations have been carried out both without and ith the exchange terms. Discussion of similarity ansformations lead to the virial theorem and to orrelation of solutions for different Z values. A.

536.71 : 533.21

4745. Compressibility of gases as a function of mperature. DUCLAUX, J. *C.R. Acad. Sci., Paris*, **27**, 1124–6 (*Nov.* 29, 1948) *In French.*—By plotting alues of $P(V - b)/RT$ as ordinates against values of $g(V - b)$ as abscissae in the case of the isotherms f N at temps. ranging from −141·5° to −23·6°, he author shows that all the isotherms are derivable ne from another by a simple change of scale of bscissae, the appropriate multiplying factor being a nction of temp. only. This result has been shown to apply likewise to O and A. In the calculations, values of the co-volume, b, in the case of any one gas are assumed to be constant, independent of pressure and temp., although a small variation of b can be admitted, with advantage, in the neighbourhood of the critical point. The relation is verified for the 3 gases in question save possibly for temps. within 2 or 3 degrees of the critical temp. and for pressures $> \frac{2}{3}$ of the critical. The result is explicable on the assumption of progressive association occurring in the gas under increasing pressure. J. S. G. T.

536.71 : 541.126 : 533.75

An equation of state for gases at extremely high temperatures and pressures from the hydrodynamic theory of detonation. *See Abstr.* 4568

536.752 : 537.567

4746. The entropy of a gaseous mixture in ionization equilibrium. SCHATZMAN, E. *Bull. Acad. Roy. Belge, Cl. Sci.*, **34** (*No.* 10) 748–53 (1948) *In French.*—Formulae are given for the calculation of entropy when atoms have several degrees of ionization. Calculations are given for O. R. A. N.

536.791

4747. The Nernst theorem and the theory of real gases. POPOFF, K. *Ann. Phys., Paris* (*Sér.* 12) **3**, 725–7 (*Nov.–Dec.*, 1948) *In French.*—Summary only of a paper with extensive numerical tables which owing to present difficulties cannot be printed. The conditions to be satisfied by the functions on which entropy depends in order that the curve representing the latter shall have the correct singularities as $T \to 0$ are first examined. Having found these, the equation of state for a real gas is sought and found to be of the form $pv = RT^{1+\alpha}$ or $(p + a/v^2)(v - b) = RT^{1+\alpha}$ with the condition that in the region of $T = 0$, α is a positive quantity. The first of these equations is then used to compute the value of α from the data for a number of real gases and it is found to be positive at low temps. This implies that C_v and $C_p \to 0$ as $T \to 0$. F. E. H.

ELECTRICITY 537

THEORY . ELECTRONS 537.1

537.122

4748. On the classical theory of the electron. I. UTIYAMA, R. *Progr. Theor. Phys.*, **3**, 114–23 (*April–June*, 1948) *In English.*—In analogy with Wentzel's quantum mechanical theory, these papers will give a classical theory of a point electron free from infinite self-energy. P. M. D.

537.122 : 530.145

4749. Quantum theory of the point electron. II. SCHÖNBERG, M. *An. Acad. Brasil. Ciênc.*, **20** (*No.* 4) 309–31 (1948) *In English.*—The proposed q-number theory [Abstr. 860 (1949)] is further examined. Equations are given with a first and a second approximation to the attached potentials; the first approximation leads directly to the Møller interaction between electrons. Finally radiative interactions are considered. G. J. K.

537.133 : 539.152.2

4750. The magnetic moment of the proton. TAUB, H. AND KUSCH, P. *Phys. Rev.*, **75**, 1481–92 (*May* 15, 1949).—The molecular beam magnetic resonance method has been employed to measure, in the same magnetic field, the frequency corresponding to a reorientation of the proton in the molecule NaOH and the frequency corresponding to a transition between certain of the h.f.s. levels of the ground state of both the atoms Cs^{133} and In^{115}. From these data are calculated the ratio of the *g*-factor of the proton, g_H, to the *g*-factor of total electronic angular momentum, g_J, with the result $g_H/g_J(Cs, {}^2S_{\frac{1}{2}}) = 15{\cdot}1911 \times 10^{-4}$ and $g_H/g_J(In, {}^2P_{\frac{1}{2}}) = 45{\cdot}6877 \times 10^{-4}$. From a knowledge of the ratios $g_J(Cs^{133})/g_J(Na^{23})$ and $g_J(In^{115})/g_J(Na^{23})$ two entirely independent values of the ratio $g_H/g_J(Na^{23})$ have been obtained: From In, $g_H/g_J(Na) = 15{\cdot}1923 \times 10^{-4}$. From Cs, $g_H/g_J(Na) = 15{\cdot}1931 \times 10^{-4}$. From the known value of $g_s/g_l = 2(1{\cdot}00116)$, where g_s and g_l are, respectively, the *g* factors of electron spin and of orbital angular momentum, and on the basis of the assumptions that $g_s = g_J$ and that $g_l = 1$, $g_H = 30{\cdot}4206 \times 10^{-4} \pm 0{\cdot}005\%$. Including a small diamagnetic correction, the magnetic moment of the proton, μ_H, is $(15{\cdot}2106 \times 10^{-4} \pm 0{\cdot}005\%)$ Bohr magneton. A.

537.133 : 539.185

On the magnetic moments of the proton. *See Abstr.* 5007

537.133 : 539.185 : 530.145

Magnetic moment of the proton. *See Abstr.* 4467

ELECTROSTATICS . DIELECTRICS 537.2

537.22 : 537.24

4751. On J. I. Frenkel's article "Mechanism of electrification of solid and liquid bodies in splitting." MUCHNIK, V. M. *J. Exp. Theor. Phys., USSR*, **19**, 469–70 (*May*, 1949) *In Russian.*—See Abstr. 566 (1949).

537.221

4752. The contact between a solid and a liquid electrolyte. GRIMLEY, T. B. AND MOTT, N. F. *Disc. Faraday Soc.* (*No.* 1) 3–11, *disc.* 43–50 (1947).—The conditions holding at Ag/AgBr and Ag/(solution containing Ag^+ and Br ions) interfaces are examined theoretically and it is shown that the p.d. between Ag and the bulk of the AgBr crystal is 1·4 V. The charge distribution in the double layer is also discussed. The calculation shows that the concentration of vacant lattice points in the layer neighbouring the Ag/AgBr interface is $\gg$ that in the bulk of the AgBr crystal. The p.d. between the bulk of the AgBr crystal and the solution is calculated and the p.d. between the bulk of the solution and the surface of the crystal is related to the concentration of interstitial Ag ions in the lattice and the distance from the interface of the point of reference. J. O'M. B.

537.221 : 548.736.4 : 621.315.61

4753. On new varieties of barium titanate. VUL, B. M. AND GOLDMANN, I. M. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 1) 41–3 (1948) *In Russian.*—I shown that if $BaTiO_3$ is prepared from chemi pure materials the product obtained has normal dielectric properties, the permittivity b ~ 50, and practically independent of the te in contrast with the high permittivity of Ba prepared from technically pure materials. latter type, e.g. at room temp., has a tetrag crystalline lattice with $a = 3{\cdot}98$ Å, $c = 4{\cdot}$ while $BaTiO_3$ prepared from chemically materials containing a small amount of rutile a structure approximating to a rhombohe lattice in which $a = b = c = 4{\cdot}04$ Å with an a ~ 90°. A small amount of rutile could not acc for the sharp decrease in the permittivity. mittivity/temp. curves are given for $BaTiO_3$ prep from chemically pure materials, and for BaTiO which 2% $Al(OH)_3$ and 1% $SrCO_3$ mol. wt. respecti have been added. Chemically pure $BaTiO_3$ ha curve parallel to temp. ordinate while the oth curves have Curie points and vary considerably temperature. W

537.2

4754. Applications of a formula for the inte field strength [of a dielectric]. BÖTTCHER, C. J. *Chem. Weekbl.*, **43**, 652–7 (1947).—A satisfac relationship must explain experimentally establi deviations from the classical equations of Lor Lorentz, Clausius–Mosotti, and Debye, inclu (i) the variation of the mol. polarization P_m in case of a non-polar gas, e.g. CO_2, with pressure v it passes through a max. at ~ 250 atm., (ii) variat in the polarization of ions in a crystal lat which are > those predicted by Fajans and J. (iii) differences between crystals and powd crystals, and (iv) deviations in the case of electro in solution. Corrections introduced in Onsa equation are too small to explain the experime results. A new equation is suggested in whi correction g_i is introduced into the Clausius–Mo formula such that $g_i = 1$ when $\varepsilon = 1$, rising max. g_m when $\varepsilon_m^2 = (1 + 2k)/(1 - k)$ and $\alpha/r^3 = 0{\cdot}1$—$0{\cdot}8$ for different materials. equation satisfactorily represents the experime results with regard to (i) and (iv) above, and a si equation may be applicable to crystals but recorded measurements are not accurate enou check this point.

537

4755. Theory of dielectric polarization. KRUIS C. A. *Chem. Weekbl.*, **43**, 633–44 (1947).—A cri review of most recent theories for non-polar dipolar dielectrics, particularly those of Kirkw Debye and Onsager, and Böttcher. It is concl that there is as yet no theory which can predict magnitude of the dielectric polarization for particular liquid, but it is quite clear where difficu lie and where theory needs improvement. Diele polarization depends to a marked extent on de of structure in the liquid, which are very difficu bring into consideration on the present stat knowledge. In spite of this difficulty very results have been achieved in the case of non-p liquids by using Böttcher's formulae, which co an empirical element. Dipolar liquids are

epresented by Kirkwood's formulae, but the cal- ulation of cos γ offers considerable difficulty. B. A.

537.226

4756. On Kronig's theory of relaxation and its pplication to the case of polar liquids. Budó, A. *Iungar. Acta Phys.*, **1** (*No.* 3) 16–24 (1948) *In English.* –This theory is applied to the study of the conditions nder which there is more than one relaxation time, nd found to lead to the correct formulae for the ielectric relaxation in polar liquids. L. P.

537.226 : 591.11

4757. The temperature dependence of the dielectric onstant of blood at low frequencies. Schwan, H. *Naturforsch.*, **3b**, 361–7 (*Sept.–Oct.*, 1948) *In erman.*—The dielectric constant ε is about 4 000 at 0 kc/s and rises at lower frequencies. Owing to the igh conductivity tan δ may be $> 3\,000$ at 2 kc/s, so iat the accurate measurement of ε is difficult. A ridge built around a 5 Ω slide-wire is analysed and iown to be capable of 1% accuracy in ε. Electrode nd cell details are given. Measurements over –34°c on centrifuged blood show ε almost constant t about 3 700, while the conductivity has a temp. oeff. $> 2\%$/deg c. F. F. R.

537.226 : 621.315.6

4758. Digest of literature on dielectrics (Vol. X, anuary 1946–January 1947). [*National Research ouncil, Washington, D.C., U.S.A.*] (1948) 120 *pp.*—he 10th volume of the digest, formerly called Contributions of the Chemist to Insulation Re- earch," comprising the sections Electrical Properties f Matter, Ceramic Insulation, Synthetic Plastic nsulation, Progress in Rubber Insulation, Insulating aper, Insulating Oils, History. Very full biblio- raphies are given.

537.226 : 621.315.61.011.5

4759. Electrical properties of solids. I. Dielectric roperties of solids. Schmelzerch, H. *FIAT Rev. erman Sci.* (1939–46) [*Off. Mil. Govt. Germany*] *Physics of Solids, II*," 43–52 (1948) *In German.*—he Debye theory of solid dielectrics is outlined, and n extension due to Holzmüller giving the dipole ioment for a polar molecule calculated from classical inetic theory is given. It is shown how the temp. ependence of the dielectric loss leads to a value for ie relaxation time for the molecule. Reference is iade to work on high polymers with substituted polar roups over the frequency range 50 to 10^7 c/s. Measurements of the dielectric constant ε for hosphors containing various activators is shown to idicate the effect on the lattice structure of the basic ubstance caused by the introduction of the activator iolecules. Measurements on ceramics especially at igh frequencies (up to 2 000 Mc/s) are recorded. he dielectric properties of amorphous and crystalline uartz were investigated, and, using the immersion ethod, Glemser measured ε for various metallic xides and hydroxides. He found that ε was greater or synthetics than for the corresponding natural ineral, and that if the melting point were exceeded uring the pre-heating of a synthetic material the alue of ε would fall. C. A. H.

537.226.1

4760. Dielectric properties of titanates of the erovskite type. Jonker, G. H. and van Santen, J. H. *Chem. Weekbl.*, **43**, 672–9 (1947).—The dielectric properties of a series of cubic titanates and the variations with temp. are described and interpreted satisfactorily with the help of the Clausius–Mosotti equation. B. A.

537.226.1

4761. High dielectric constants. van Santen, J. H. *Chem. Weekbl.*, **43**, 657–62 (1947).—The requirements of substances having very high ε, especially as regards variation with temp., are discussed in the light of the various formulae proposed, and the dielectric behaviour of Rochelle salt and KH_2PO_4 are discussed in brief. B. A.

537.226.1

4762. Dielectric losses and temperature coefficient of the dielectric constant of amorphous solid substances. Gevers, M. *Chem. Weekbl.*, **43**, 698–702 (1947).—For a large range of insulating media and dielectrics it has been shown experimentally that the temp. coeff. of the permittivity $= 0{\cdot}05 < 0{\cdot}06\times$ loss factor. A theoretical deduction of this equation is worked out. B. A.

537.226.1

4763. Dielectric properties of plastic materials. Mol, E. A. J. *Chem. Weekbl.*, **43**, 691–8 (1947).—The dielectric properties of plastics, particularly of polyvinyl chloride and chlorinated diphenyls, are discussed in detail under the following headings: (i) effect of structure and of plasticizers; (ii) the connection between electrical and mechanical properties, internal and external η, relaxation times, and activation energies; (iii) the connection between electrical conductivity and dielectric losses; (iv) the connection between mechanical properties and dielectric losses, relaxation times, and mol. weight. It is concluded that to a first approximation the dielectric behaviour of polar high polymers can be described in terms of the direction of dipoles under the influence of an electric field against a resistance dependent on temp., correlated with an activation energy. Various methods of measurement show that a spectrum of relaxation times always has to be dealt with, the size being expressed as a parameter. The spectrum narrows as the dipole becomes more independent of the main chain and as the interaction between the long chains becomes less. It is possible to derive a relationship between the degree of polymerization and the most probable relaxation time. Results obtained in practice confirm this relationship fairly satisfactorily. B. A.

537.226.2

4764. Dielectric behaviour of single domain crystals of $BaTiO_3$. Danielson, G. C., Matthias, B. T. and Richardson, J. M. Letter in *Phys. Rev.*, **74**, 986–7 (*Oct.* 15, 1948).—The crystals, made by use of mineralizers, are large flat plates (0·5 cm long). The Curie point, dielectric constant along the major axes, variation of ε with frequency up to 10 Mc/s, and relaxation times are determined, and Weissenberg pictures show displacement of Ti or O ions to be $\sim 0{\cdot}16$ Å. C. A. H.

537.226.2

4765. Theory of the dielectric behaviour of $BaTiO_3$. Richardson, J. M. and Matthias, B. T. Letter in

Phys. Rev., **74**, 987–8 (*Oct.* 15, 1948).—The large ratio of ε perpendicular and parallel to the direction of spontaneous polarization, and the variation of ε with frequency, are explained by quantum-mechanical methods applied to the ideal crystal. The dielectric anisotropy above the Curie point (122°C) is not explained. C. A. H.

537.226.2 : 548.0

4766. Notes on the properties of synthetic rutile single crystals. Zerfoss, S., Stokes, R. G. and Moore, C. H. *J. Chem. Phys.*, **16**, 1166 (*Dec.*, 1948).—Very high dielectric-constant values can be obtained for synthetic rutile single crystals by appropriate treatment. When the crystals were oxidized the dielectric-constant values were those usually obtained for rutile, but if they were then subjected to treatment in H for short periods, dielectric-constant values of about 20 000 and resistivity values of between 10^5 and 10^6 Ω-cm were obtained. The dielectric constants for the principal directions increased initially upon reduction, but finally approached a common value in the well reduced material (blue in colour), which appeared to be identical in properties with the original black material from the furnace. The reduced material did not appear to be ferroelectric. E. R.

537.226.3

4767. The effect of molecular inertia on dielectric absorption. Powles, J. G. *Trans. Faraday Soc.*, **44**, 802–6, 844 (*Oct.*, 1948).—The analogues of Debye's dielectric loss expressions are derived retaining the moment of inertia, I, in the equations of rotational motion. For low dipolar concentrations

$$\frac{\tan\delta}{\tan\delta_{(I=0)}} = \frac{[1+(1-\alpha)x][1+(\omega\tau)^2]}{[1-x(\omega\tau)^2]^2+(\omega\tau)^2[1+(1-\alpha)x]^2}$$

where $x = I/(2kT\tau^2)$ and α $(0 \leqslant \alpha \leqslant 1)$ arises as a correction to the mean-square angular diffusion rate. For actual solutions in benzene, the total correction to the Debye formulae is < experimental errors even at the highest frequencies available. D. H. W.

537.226.3 : 621.315.617.011.5

4768. Hystero-viscosity in silicone. Malti, M. G. and Chatterjee, A. K. *Trans. Amer. Inst. Elect. Engrs*, **67**, *Pt I*, 369–73 (1948).—The variation of hystero-viscosity loss with the period of charge or discharge, with the interval between successive charges and discharges as well as with the maximum applied voltage is measured on a sample of silicone resin. It is found that the loss is expressible as follows: $W = aE_m^2(1 - E^{-bt_1})E^{-c(t_p-T_0)^2}$, where W = energy loss, a, b, c, T_0 are positive material constants, E_m = max. applied voltage, and t_p, t_l = respectively, the period of charge or discharge and the interval between successive charges or discharges. Experimental details and test procedure are described. A. M. T.

537.228 : 548.0

4769. Piezo-electric-optical Kerr effects in crystals: application of group theory. Suryanarayana, D. *Proc. Indian Acad. Sci. A*, **22**, 148–9 (*Sept.*, 1945).—The method given by Bhagavantam [Abstr. 1803 (1943)] has been extended for the purpose of obtaining the number of independent constants needed to describe the piezo-electric and the electro-op Kerr effects in the 32 classes of crystals. The res agree in all cases with those derived directly.

537.22

4770. Electrical properties of solids. II. Pi electric properties of solids. Gerber, E. *FIAT German Sci.* (1939–46) [*Off. Mil. Govt. Germ "Physics of Solids, II,"* 53–62 (1948) *In Germa* The piezo-electric and elastic constants of crys are defined and a method of measuring the pi electric properties due to Spitzer is described, and been applied to various salts by Scholtz. The rela between the elastic and piezo-electric constants been investigated theoretically and from the resona frequency the elastic constants may be deduced. resonance resistance, inductance, frequency, and damping of the various oscillating parts have b investigated for quartz which vibrates longitudin in its characteristic frequency. Results of meas ments for various Na and NH_4 salts are given. theoretical part treats both stretching and shea oscillations, the phenomenon as both a surface an volume effect, and shows how to calculate the m and amplitude of oscillation. C. A

537.228.1 : 534.85 : 621.396.622 : 621.31

4771. New synthetic piezoelectric mate Howatt, G. N., Crownover, J. W. and Drametz *Electronics*, **21**, 97–9 (*Dec.*, 1948).—Pure Ba titan fired into a ceramic, will exhibit permanent pi electric properties on the application of a polarizing field. As applied to microphones gramophone pick-ups, two elements ~0·01 in t are bonded together, the effect then being produ on bending. Optimum thickness is a compro between low compliance and adequate breakd strength, and optimum width a compromise betw achieving a flat response at l.f. and avoiding los sensitivity through high capacitance. Freque characteristics and curves of permittivity, tan δ sensitivity against temp. are given. A poss physical explanation is suggested and compari are made with natural piezo-electric materials. method of manufacture is outlined. H. G. M. S

ELECTRIC CONDUCTION . CURRENTS 5

5

4772. Thermal electrical fluctuations in an elec lyte. Pumper, E. Ya. *Dokl. Akad. Nauk, SS* **59** (*No.* 8) 1415–16 (1948) *In Russian.*—Johns measurements of the energy of fluctuations electrolytes [Abstr. 2811 (1928)] have been repe over a greater frequency range and with a sma mean error. The order of magnitude of the elect resistance of the column of a diluted aqueous s tion of KCl varied from 10^4 to 10^5 Ω. Resist measurements were carried out using alterna current whose frequency was almost identical that of the current used for the actual research. energy of fluctuations was estimated from the v of k' (Boltzmann constant value as obtained f Nyquist's formulae). The initial values were alv

3–4% higher than theoretical, which is due to a small polarization e.m.f. When the electrolyte was left short-circuited for 24 hr, the initial value of $k' = 1{\cdot}435 \times 10^{-16}$ erg/degree dropped to $(1{\cdot}36 \pm 0{\cdot}011) \times 10^{-16}$ erg/degree. F. L.

537.3

4773. Conversion of a motor generator into a low noise power amplifier. SOMMERS, H. S., JR., WEISS, P. R. AND HALPERN, W. *Rev. Sci. Instrum.*, **20**, 244–51 (*April*, 1949).—The noise output of motor-generator sets is so large as to impair their use in precision control work. This paper describes a method for reducing this noise by incorporating a motor-generator in an electronic feedback circuit. The method is based on the use of a high frequency output channel in parallel with the generator to permit cancellation of the higher harmonics of the noise. Design, construction and performance of an amplifier based on a ½ kW set are described. The noise output of this unit is ¼% of the normal noise of the generator. A.

537.3 : 537.533 : 530.162 : 621.38

4774. On the theory of electrical fluctuations. MACDONALD, D. K. C. *Proc. Roy. Soc. A*, **195**, 225–30 (*Dec.* 7, 1948).—A criticism of a paper by Fürth [Abstr. 1240 (1948)]. Objection is taken to Fürth's theory treating the fluctuations of electric current in a valve on a basis of thermodynamic equilibrium. His treatment of space charge problems is also criticized. L. S. G.

537.311 : 621.315.61

4775. Methods for reducing insulator noise and leakage. GLASS, F. M. *Rev. Sci. Instrum.*, **20**, 239–41 (*April*, 1949).—A recent study of the insulator problem involved in radiation detection instruments disclosed the fact that insulators, in high-impedance input circuits, are the predominant source of background noise when subjected to high voltages and high humidities. Methods for eliminating this trouble in some of the commonly used circuit components, and new and superior insulating materials, were found. A.

537.311.3 : 538.222

4776. The nature of metal-ammonia solutions. II. BIRCH, A. J. AND MACDONALD, D. K. C. *Trans. Faraday Soc.*, **44**, 735–42 (*Sept.*, 1948).—See Abstr. 1851 (1948).

537.311.31

4777. Electrical properties of solids. VI. Conduction of electricity in metals. HETTNER, G. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 123–30 (1948) *In German.*—The Bloch collective electron scheme has been modified by Sauter, who has also extended the Lorenz–Sommerfeld ideas on the stationary distribution. Kohler has shown how to obtain the T^5 law found at low temps., and by consideration of the elastic anisotropy has been able to calculate the correct values of the Debye characteristic temps. for certain metals. The theory of the variation of resistance in a magnetic field has been given by Kohler and by Justi. In view of the many parameters that determine the electrical conductivity of a particular metal specimen it is concluded that a universal theory of conduction in metals is not possible. Meixner has obtained formulae for the temp. coeffs. of resistance at constant pressure and volume in terms of the expansion coefficient, compressibility and coefficient of variation of resistance with pressure. Methods of measurement and experimental results for a large numbers of metals and alloy systems are quoted. C. A. H.

537.311.33

4778. Photoelectric emission and contact potentials of semiconductors. APKER, L., TAFT, E. AND DICKEY, J. *Phys. Rev.*, **74**, 1462–74 (*Nov.* 15, 1948).—The energy distribution of external photo-electrons from the semi-conductors Te, Ge and B, were compared with those of several metals, using spherical photo-cells with interchangeable emitters. For semi-conductors there was a pronounced sparsity of electrons with energies near the Einstein maximum. Sharply defined stopping potentials corresponding to upper edges of occupied bands were not observed. The semi-conductors used were of the deficit type. Upper limits for the width of the forbidden bands can be deduced from the experimental results and the thermionic work-functions of Te, Ge and B were determined. Photo-currents observed for wavelengths which correspond to levels within the forbidden band may be due to surface states. The density of such states was estimated as 10^{12}/cm². H. K. H.

537.311.33

4779. Determination of the resistivity of anisotropically conducting homogeneous media by means of the four-point method. BUCHHEIM, W. *Geofis. Pura. Appl.*, **10** (*Nos* 3–4) 102–13 (1947) *In German.*—A theoretical method for calculating the resistivity is presented. This involves Laplace's equation and the determination of the current-density vector. The "anisotropic paradox" is expressed in general form and the significance of this in measurements of the resistivity is explained. L. S. G.

537.311.33

4780. Temperature variation of the electrical properties of nickel oxide. WRIGHT, R. W. AND ANDREWS, J. P. *Proc. Phys. Soc., Lond. A*, **62**, 446–55 (*July*, 1949).—An experimental method of preparing specimens of NiO in the form of coherent strips is described. Simultaneous measurements of electrical conductivity σ and Hall effect R are then made at various temps. up to about 700°C and the thermo-electric power dE/dT measured immediately afterwards, all on one sample. The experiments are then repeated on different samples, and they show that $\log \sigma$, $\log R$ and dE/dT are linear functions of $1/T$, where T is the mean absolute temp. of the specimen. The graphs for $\log \sigma$ and $\log |R|$ against $1/T$ each consist of two rectilinear portions, one covering the high, the other the low temp. results. Thermo-electric measurements yielded results only for the high temp. part. The theory of impurity semiconductors is developed and found adequate to explain the variation, at any rate at higher temps. It is found that an activation energy of about 2 eV at high temps., and from 0·3 to 0·64 eV at low temps., is required for excitation of electrons to the conduction band. The concentration of impurity centres operative in the high temp. range is about $8{\cdot}6 \times 10^{20}$, the electrons

having a mean free path of about 10^{-6} cm. The concentration of free "carriers" varies from 10^{11} to 10^{13} as the temp. rises. NiO behaves like a defect semiconductor, "hole" conduction predominating. The significance of these results is discussed. A.

537.311.33

4781. Electrical properties of solids. III. Conduction of electricity in insulators; photoconductivity. VON MEYEREN, W. A. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 63–76 (1948) *In German.*—Substances with a room temp. resistivity $> 10^{10}$ Ω-cm and the processes of ionic, electronic and mixed conduction are treated. Smekal showed that the conduction in NaCl was due to the motion of ions and of lattice sites. Karabascheff found a dependence of current I on time t and that $dI/dt \propto U^2$ (U being the applied potential), and the results were interpreted by Mollwo. A new theory of diffusion in solids was put forward by Franz. The influence of impurities on conductivity was investigated for CdS phosphors by Ruffler, and for KCl with $CaCl_2$ introduced, by Mollwo, who found that the ionic conductivity $\chi_i = (N_{th} + N_z)ev_0$ where N_{th} was number of ions diffusing thermally, N_z the number of vacant sites, and v_0 the mobility. The conductivity in long-chain fatty acids was measured by Thiessen who found no dependence of χ on crystal orientation. The values of χ for thin films of fatty acids and also for various ceramic materials were found. Jensen found the magnetic moment of F-centres in KBr crystals to be 1·9 Bohr magnetons (within 10%), i.e. within the range of accuracy claimed for electrons in the ground state, his method involving the measurements of magnetization of KBr and KH-substituted KBr together with the u.v. absorption spectrum. Pick measured binding energies in KCl with varying contents of $CaCl_2$, $BaCl_2$ and $SrCl_2$, and found further absorption bands. The primary and secondary photocurrents in thin KCl plates were investigated by Rögener, and Domanic made low temp. measurements on K coloured KBr and KCl. Mollwo produced conduction in KBr by melting with a small quantity of KNO_3 which dissociates in heat into KNO_2/KNO_3 mixture with free O. Br diffuses into the hot crystal with the reaction $2KNO_2 + Br_2 = KNO_3 + KBr + NOBr$. Such crystals absorb below 260 mμ. Work on ZnS phosphors and the use of radioactive tracers in KCl and NaCl is mentioned. C. A. H.

537.311.33

4782. Electrical properties of solids. IV. Conduction of electricity and photoelectric effect in semi-conductors. VON MEYEREN, W. A. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 77–100 (1948) *In German.*—Recent trends in work on the subject are reviewed. Results of measurements of all the electrical properties of various forms of Se, including the effect of crystal size on the conductivity of pure Se are given. The investigation of PbS includes work on pressed specimens and on evaporated layers, and some early work on PbSe is described. The properties of α-Ag_2S are further investigated, the conductivity decreasing with increasing partial pressure of S vapour. UO_2 and U_3O_8 were measured at 800 to 1 000°c and the conductivity was independent of O vapour pressu... The basic ceramic materials, Al_2O_3, BeO, ZrO_2 a... ThO_2 showed characteristic semi-conductor p... perties for the variation of conductivity with tem... Certain electronic semi-conductors, NbC, NbH a... NbN, showed superconductivity phenomena in t... temp. region 15 to 23°K. Photoelectric propert... of Cu_2O, Se, CdSe, Group VI oxides and telluride... PbS and PbSe, are summarized, and the experimen... results are explained. The Fowler theory has be... extended by various workers to explain the selecti... photo-effect in various semi-conductors. C. A.

537.311.

4783. Temperature dependence of the work functi... of semiconductors. SMITH, A. H. *Phys. Rev.*, ... 953–8 (*March* 15, 1949).—Samples of *P*-type a... *N*-type Si and of *N*-type Ge have been examined ... determine the temp. dependence of the work functi... as they are heated to near intrinsic temps. Hi... temps. of the semiconductors were obtained ... passing current directly through the sample, a... observations were made as the sample cooled. T... method of determining change in work function w... to observe the current v. voltage curves of pho... electrons emitted from a Ta surface and arriving ... the semiconductor surface. This experiment indicat... negligible change in work function of semiconducto... at high temps. from that at 200°c. These results ... consistent with the hypothesis of surface ener... states.

537.311.

4784. The effect of surface states on the temperatu... variation of the work function of semiconducto... MARKHAM, J. J. AND MILLER, P. H., JR. *Phys. Re...* **75**, 959–67 (*March* 15, 1949).—The variation of t... electrochemical potential is given on the basis of ... equation due to Fowler. An attempt is made to sh... at what temp. a semiconductor becomes intrins... The temp. variation of the work function is consider... for various densities of surface states and numbers ... donator (or acceptor) levels. To carry this calculati... through a new expression, which is temp.-depende... is suggested for the number of electrons in the surfa... states. By using appropriate values obtained fr... experiment one is able to explain Smith's resu... [preceding Abstr.].

537.311.

4785. Non-rectifying germanium. DUNLAP, W. ... JR., AND HENNELLY, E. F. Letter in *Phys. Rev.*, ... 976 (*Oct.* 15, 1948).—Plane-welded Ge conta... rectifiers, made from Ge oxide reduced in lo... pressure H, are found to show very little barrier-la... rectification. The units are *P*-type at −196... reversing to *N*-type at 70°c. The contact resistan... averages 2 900 Ω. The small amount of rectificati... is considered to be due to inhomogeneities in the ... caused by heating. The magneto-resistance and ... variation of Hall coefficient with magnetic fi... intensity are both large. C. A.

537.311.33 : 537.31...

4786. The production of photo-e.m.f.'s in sem... conductors. LASHKAREV, V. E. *J. Exp. Theor. Phy... USSR*, **18**, 917–26 (*Oct.*, 1948) *In Russian.*—T... semi-conductors considered are supposed to posse...

a dark conductivity due to carriers of one sign only. The influence of the contact fields is taken into account. It is assumed that photoelectrons and photo-holes very quickly lose their residual energy. The calculations are carried out completely for the case of weak irradiation. It appears that the sign of the photo-e.m.f. is fully determined by the sign of the contact field and the sign of the dark current carriers. The photomagnetic effect is calculated on the same theory. The relation between the concentration of the photoelectrons and the residual holes is determined. A.

537.311.33 : 537.312.5

4787. Photo-e.m.f.'s in copper oxide. LASHKAREV, V. E. AND KOSONOGOVA, K. M. *J. Exp. Theor. Phys., USSR*, **18**, 927–36 (*Oct.*, 1948) *In Russian.*—It is shown that the sign of the photo-e.m.f.'s is fully determined by the conditions in the region of contact between metal and semi-conductor. The qualitative agreement of the experimental results with the theory developed by Lashkarev [see preceding Abstr.] is seen. The spectral distribution of +ve and −ve photo-e.m.f.'s in copper oxide is investigated, and the observed differences are discussed. A.

537.311.33 : 538.221

4788. Remarks on the ferromagnetism of the semi-conductors. YAMAMATO, T. AND TAKAGI, S. Letter in *Progr. Theor. Phys.*, **2**, 160–1 (*July–Oct.*, 1947) *In English.*—The ferromagnetism of semi-conductors is discussed for a model in which each atom has 2 energy levels. At absolute zero each ground level is occupied by 2 electrons with anti-parallel spins, but as T is raised some electrons go to the upper level, and it is assumed that ferromagnetism arises from interactions of unpaired electrons in the ground level. Curves of saturation moment as function of T are calculated by both the Bragg–Williams and the Bethe method; both show upper and lower Curie points, but the Bethe method gives a much smaller max. saturation. D. S.

537.312.5 : 535.215

4789. On the residual current in photoelectric cells of very high sensitivity. DUCHESNE, M. *C.R. Acad. Sci., Paris*, **227**, 1155–7 (*Nov.* 29, 1948) *In French.*—This is a study of the relationship between the parasitic emission and cathode temp., utilizing a fluorometric method. At low temps. the residual cathodic current does not conform to Richardson's equation. The deep-cooling of the photocathode results in a modification of the work-function. Deep-cooling also reduces the residual current and increases the photoelectric sensitivity of the cathode layer. W. S.

537.312.62

4790. Electrical properties of solids. VIII. Superconductivity. MEISSNER, W. AND SCHUBERT, G. U. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 143–62 (1948) *In German.*—Several new materials are listed as superconductors, including the hydride, carbide and nitride of Nb. Other experimental results of Justi and his collaborators are recorded as well as measurements of the magnetic properties. The theoretical work includes an extension by von Laue of London's 1937 theory, some thermodynamic ideas by Sommerfeld, an electron theory due to Welker, and a recent (1946) concept of the superconducting process by Heisenberg. C. A. H.

537.312.62

4791. Destruction of superconductivity by current. SCOTT, R. B. *J. Res. Nat. Bur. Stand., Wash.*, **41**, 581–8 (*Dec.*, 1948).—A series of measurements was made of the return of resistance in superconducting wires when the current was increased up to and beyond the critical value. Wires of pure In of 3 different diameters were used, and measurements were made on each wire at 4 different temps. The transition curves for a wire of given diameter were reproducible and were independent of temp. Measurements on short wires 0·6 mm in length gave substantially the same results as measurements on long wires. The fraction of the normal resistance restored by the critical current varied from 0·77 for a wire 0·36 mm dia. to 0·85 for wires 0·11 mm dia. The classical formula predicts a value of 0·50. The results are discussed in the light of Landau's theory of the intermediate state, and it is shown that the classical value may be approached for wires of large diameter. A.

537.312.62

4792. On the theory of superconductivity. BORN, M. AND CHENG, K. C. *J. Phys. Radium*, **9**, 249–52 (*Oct.*, 1948) *In French.*—An outline is given of a theory of superconductivity in which the interaction of electrons and metallic ions is taken into account, and according to which (in agreement with existing data) superconductivity should occur only in those metals for which the Fermi surface is close to the corners of a Brillouin zone. The transition temps. and critical magnetic fields predicted are of the right order of magnitude. D. S.

537.312.8

4793. Measurement of the electrical conductivity of metals and alloys in a rotating magnetic field. REGEL, A. R. *J. Tech. Phys., USSR*, **18**, 1511–20 (*Dec.*, 1948) *In Russian.*—The couple exerted on a conducting sphere in a uniform rotating magnetic field is worked out and it is shown that the resulting expression can be used as the basis of a method for measurement of electrical conductivity. Considerable deviation from true spherical form has little effect on the results. Measurements of the conductivity of In are made by the couple method over a temp. range of 0 to 600°c and are shown to be in good agreement with the accepted values; the same is true of tests on Zn, Pb and Sn specimens. Full details of construction of the apparatus are given. B. H.

537.312.9 : 539.374

Increase in electrical resistance caused by deformation. *See Abstr.* 5027

537.32

4794. Electrical properties of solids. VII. Galvanomagnetic, thermomagnetic, and thermoelectric effects. MEIXNER, J. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 131–42 (1948) *In German.*—A generalized thermodynamic theory for all the effects, due to Meixner, is outlined. Other theoretical work includes the dependence of

thermoelectric power on the orientation of the specimen crystal, on contact e.m.f.'s between metals, and on the isotropic nature of the electron gas. Experimental results for the effects in various metals and semi-conductors are quoted. The Hall effect in PbS and in α-Ag_2S is measured and it is confirmed that α-Ag_2S is an excess semi-conductor. C. A. H.

537.32 : 536.75

4795. Thermoelectricity, thermomagnetic and galvanomagnetic transverse effects, treated from the standpoint of the differential equation for the entropy. LOHR, E. *S.B. Öst. Akad. Wiss., Abt. IIa*, **156** (*Nos* 7–8) 355–81 (1948) *In German.*—The standard thermodynamic treatment of the subject is summarized and its limitations shown. The differential equation for the entropy is derived from Maxwell's second electromagnetic relation, and from the solution and interpretation of this equation all the thermoelectric properties of metals can be deduced, one term of the equation governing the heat conduction and the law of Wiedemann and Franz. The other effects are similarly treated. C. A. H.

537.322

4796. Thermo-electric properties of monovalent metals. SEROVA, F. G. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 460–8 (*May*, 1949) *In Russian.*—The Thomson coefficient ρ at high temperatures of Li and Na is calculated, considering the effect of electrons transported by a current of phonons; the substantially different kind of dependence of the mean free path of the electrons on the energy compared with that of free electrons is pointed out. A positive value of ρ is found, in agreement with the experimental data for Li. The calculations show that the positive value of ρ is due to the "transport" effect. For Na the effect is not appreciable. B. F. K.

537.322.1

4797. Contribution to the study of the thermo-electric power of metals. CRUSSARD, C. AND AUBERTIN, F. *Rev. Métall.*, **45**, 402–10 (*Oct.*, 1948) *In French.*—The thermoelectric properties of the pure metals Cu, Al, Fe, Ni were measured at low temps. ($\sim$ 100°C) and the effects of elastic and plastic distortion investigated. In the case of Cu a linear relationship between thermoelectric power and elastic extension was found. The effect of plastic distortion on metals with cubic structures was attributed to hardening. The investigation of the effect of small quantities ($\sim$ 0·1%) of impurity in Al and a study of an Al-Cu (4% Cu) alloy led the authors to suggest that the method has metallographic applications, e.g. the accurate tracing of equilibrium diagrams in the region of very small concentrations of elements with very limited solubility. H. P. M.

537.33

4798. Thermo-electric and conductive properties of blue titanium dioxide. HENISCH, H. K. *Elect. Commun.*, **25**, 163–77 (*June*, 1948).—A simple theory of thermoelectric effects in semi-conductors is developed. It is shown how measurements of thermo-power at various temps. can be interpreted in terms of the concentration of free charge carriers (electrons or positive holes) and their activation energy. Special attention is given to the disturbing effect of ne uniformities in the impurity content on the expe mental results. From a comparison of therm electric and resistive properties for a series specimens, conclusions can be drawn as to the relat magnitude of intergranular resistances and the b resistivity of individual grains. The therm electric properties of TiO_2 (containing a stoich metric excess of metal) were found to be in substant agreement with theoretical prediction between 97 and 617°K. The activation energies thus evalua were, however, < those obtained from the measu ment of resistivity at different temps. This and oth problems in connection with the interpretation activation energies are discussed in the light Lichtenecker's theory of solid mixtures. H. K.

537.3

4799. Location of menisci and measurement of t conductivity at every point of an electrophore diagram. DE MENDE, S. AND VERGNOLLE, J. C *Acad. Sci., Paris*, **227**, 1235–7 (*Dec.* 8, 1948) *French.*—A method of detection of menisci in electrophoresis cell is described in which the liq in the cell is effectively divided into 2 adjoini columns by 3 electrodes, and the ratio of the electri conductivities of the liquid columns is measur The liquid is made to move along the longitudi axis of the containing tube and when a menisc passes an electrode the conductivity ratio chan abruptly. A graph is included showing the detecti of menisci with solutions of 2 albumins in phospha buffer. The results agree with those obtained usi the Svensson optical method, and the conductiv method is simpler to apply. J. O'M.

ELECTRIC DISCHARGES 537.52

537.52 : 621.315.1.015.5

4800. Precipitation on conductors under coro conditions. BOGDANOVA, N. B. AND VOROBIEV, A. *J. Tech. Phys., USSR*, **18**, 1185–8 (*Sept.*, 1948) *Russian.*—The deposition of moisture on conducte under corona was studied on single conducte facing a plane, a conductor within a coaxial cylind and two parallel conductors, under d.c. and a conditions. The artificial precipitation reached maximum of 1 mm/min. Ice formation was a studied. The current measured on moist conducte was always > on dry ones. If the corona preve deposition of moisture and icing of the conducto which is the case above a critical voltage, the curr tends towards its normal intensity with rising coro voltage. The volt/ampere characteristics taken th enable deductions to be made concerning the moist deposited on the conductors. The voltages actua preventing any moisture from being deposited well as ice formation) were determined in a num of cases. B. F. K.

537.52

4801. Calculation of spark breakdown voltages air at atmospheric pressure. PEDERSEN, A. *Appl. S Res.*, **B1** (*No.* 4) 299–305 (1949) *In English.*—Afte

brief discussion of the different sparking criteria proposed during the last decades a new semi-empirical criterion for spark breakdown in air at atmospheric pressure is briefly mentioned. It depends on the ion density and is an extension of the quantitative criterion given by Jørgensen. A.

537.525

4802. Inhibition of the light effect by resistive impedance in electric discharge. JOSHI, S. S. *Proc. Indian Acad. Sci. A*, **22**, 225–7 (*Oct.*, 1945).—An ohmic resistance, *R*, introduced between earth and the low tension electrode of a Siemens tube decreases markedly the discharge current, *i*. It does not affect the corresponding potential determined electrostatically across the ozoniser. *R* decreases markedly the percentage light-effect in *i*. This is attributed to a preferential damping of the high frequency components of *i* which are found to be the chief seat of this phenomenon. W. R. A.

537.525.3

4803. Study of Joshi-effect in iodine vapour in the presence of powdered iodine under electrical discharge. TEWARI, S. N. *Indian J. Phys.*, **22**, 553–63 (*Dec.*, 1948).—The Joshi effect, i.e. the decrease in an ozoniser discharge current when external illumination is provided, was determined for a 50 c/s 0·5—2 kV (r.m.s.) ozoniser discharge in I vapour. Special attention was paid to the influence of the current measuring circuit. J. D. C.

X-RAYS 537.531

537.53

4804. Radiative collisions between two electrons. RZEWUSKI, J. *Acta Phys. Polon.*, **9** (*Nos* 2–4) 121–8 (1947–48) *In English.*—The differential cross-section is obtained for a radiative collision between two particles described by the Dirac equation, with only static interaction. If one mass becomes very large the Bethe–Heitler formula is obtained, except at large energies where the momentum changes are large. For equal masses the radiative collision between two electrons is described. For small velocities it vanishes, but for large velocities it is of the same order as the bremstrahlung cross-section. These formulae for large energies are valid for the reverse process of pair production in the field of an electron. G. J. K.

537.531

4805. X-rays. KULENKAMPFF, H. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of the electron shells, III*," 95–130 (1948) *In German.*—Experiments with a spherical anode rotating about two perpendicular axes, are described. The result was not very satisfactory as hot spots developed on the surface of the anode. Cylindrical and spherical counters have been constructed. A spherical counter of 20 mm diameter has a sensitivity of 10^{-7} r/sec at 900 V operating voltage. The spectral energy distribution of the radiation caused by the retardation (deceleration) of the electrons [Elektronbremsstrahlen] has been investigated in the region of from 20 to 50 kV and has been found to obey the same law as has been found valid for lower voltages. The efficiency of the generation of "Bremsstrahlen" is linearly $\propto$ the electrical voltage and the atomic number of the anticathode material. At medium and high voltages, however, the simple law does not hold. New formulae are suggested and their suitability up to 2 MV is discussed. The reaction between matter and X-rays has been investigated with regard to the attenuation in matter. A table gives pertinent data for the coeff. of attenuation μ/ρ of 19 elements between Mg and Pb. An interference double refraction was shown to exist when X-rays are passing through a crystal prism. W. S.

537.531 : 535.33

4806. Continuous X-ray spectrum from 8A to 14A. STEPHENSON, S. T. AND MASON, F. D. *Phys. Rev.*, **75**, 1711–16 (*June* 1, 1949).—The continuous X-ray spectrum has been studied at voltages from 1·1 kV to 2 kV and at wavelengths from 8 Å to 14 Å using a vacuum single-crystal Geiger-counter spectrometer. The measurements were corrected for window absorption and counter efficiency but were not corrected for absorption in the target or for the reflecting power of the crystal. The total intensity in the continuous spectrum, as measured and partially corrected, is found to be $\propto$ the atomic number of the target, a result similar to results obtained for shorter wavelengths, but the total intensity is not $\propto$ the square of the voltage applied to the tube. The shapes of the curves approach the shape to be expected from a thin target. A.

537.531 : 535.3

4807. A study of the energy distribution of scattered X-radiation. PAL, H. K. *Indian J. Phys.*, **22**, 291–304 (*July*, 1948).—The scattering of white radiation by paper, paraffin wax, Al, C and S was studied at various angles from $2\theta = 20°$ to $2\theta = 150°$ and peak voltages from 30 to 100 kV. A. J. C. W.

537.531 : 535.34

4808. Interpretation of the "superfine" structure of the X-ray absorption spectra of solids. KOSTAREV, A. I. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 413–20 (*May*, 1949) *In Russian.*—The fine structure of the bands of the X-ray absorption spectra of solids is characterized not only by the position of their maxima and minima on the spectral scale, but also by their form ("hyperfine" structure) and relative intensity. It is here shown how the latter can be explained on the author's earlier theory [*J. Exp. Theor. Phys., USSR*, **11**, 60 (1941)]. Results are given of numerical calculations of the "hyperfine" structure of Cu and α-Fe. Some consideration is also given to the influence of the type of crystal lattice on the character of the fine structure of the X-ray absorption. B. F. K.

537.531 : 535.4 : 548.73

4809. Some new techniques in X-ray diffraction. FANKUCHEN, I. *Proc. Indian Acad. Sci. A*, **28**, 312–15 (*Nov.*, 1948).—A brief description of apparatus (micro-diffraction camera, split-beam double Geiger-counter spectrometer, low-temp. camera) being developed at the Brooklyn Polytechnic Institute. A. J. C. W.

537.531 : 535.43 : 615.849

4810. Approximate theoretical solution of a problem of scattering of soft X-rays [λ between 0·25 and 0·56 Å] and its consequences in medical radiology. DE WAARD, R. H. *Brit. J. Radiol.*, **21**, 454–63 (*Sept.*, 1948).—The scattering of a circular beam of X-rays incident normally on the surface of a horizontal sheet of water is investigated theoretically, and the results are shown to be in reasonable agreement with experiment. They are applied to problems arising in superficial X-ray therapy and in diagnostic radiology. C. B. A.

537.531 : 621.386.1

4811. Electron focusing in a demountable X-ray tube. THORP, J. S. *J. Sci. Instrum. Phys. Ind.*, **26**, 201–4 (*June*, 1949).—An account is given of the changes in focal pattern produced by alterations of filament setting and aperture dimensions in a "parallel-sided" focusing system used in an X-ray tube and maintained at filament potential. These patterns are characterized by the presence of two pairs of bands of which the spacing and intensity are critically dependent on the filament setting. Electron trajectories derived from electrolytic trough measurements do not correspond with the observed pattern variations. It is suggested that this discrepancy is probably due to the presence of space charge and to effects arising at the ends of the filament. A.

537.531 : 621.386.1 : 548.733

5 kW X-ray tube with rotating anode. *See Abstr.* 5122

537.531.08

4812. A new method of determining X-ray intensities. BAENZIGER, N. C. *J. Chem. Phys.*, **16**, 1175–6 (*Dec.*, 1948).—Integrated intensities of X-ray reflections recorded on film are determined by radioactive toning of the latter by means of cobalt ferrocyanide, using Co^{60}. The intensity spots were removed from the film with a punch and measured with a Geiger counter. The linear relationship between optical density and exposure was first confirmed by counting the activity of 8 standard spots which were produced on the film using a sector sensitometer. The intensities of Weissenberg diagrams were determined by the method described and agreement between counter and photometer measurements was found to be satisfactory. R. H. H.

CATHODE RAYS . POSITIVE RAYS 537.533/.534

537.533

4813. On the electrostatics of an electron stream of circular cross-section. BORGNIS, F. *Ann. Phys., Lpz.* [*Folge* 5] **43** (*No.* 8) 616–29 (1943) *In German.*—Considers an electron beam of finite cross-section, between 2 infinite planes at the same potential. The beam is found to behave, to a first approximation, as a cylinder with a constant density of space-charge. The implications of this are worked out, and consideration is also given to the case of a space-charge cylinder inside a metallic cylinder and to that of a point-charge between 2 conducting parallel plates. J.

537.533 : 621.385.1.029.6 : 621.396.645.029

4814. Dynamic electron current under the influence of dynamic fields. KÖNIG, H. W. *Acta Phys. Austriaca*, **2** (*Nos* 3–4) 312–34 (1949) *In German.*—Dynamic electron current means that transit time is comparable with period of signal; dynamic field means that electrode spacings are comparable with wavelength. In the travelling-wave tube [see Abstr. 1514 (1947)] the phase velocity of the field is slightly < the electron velocity. The present paper discusses the case of these velocities being equal. Formal similarity to the case of quasi-stationary current is demonstrated. Output voltage increases linearly with transit time if the field is quasi-stationary, but quadratically if it is dynamic. Since noise is of the same order in each case, the dynamic regime offers greater useful amplification. J. C. E.

537.533/.53

4815. Measurements of ambipolar diffusion in helium. BIONDI, M. A. AND BROWN, S. C. *Phys. Rev.*, **75**, 1700–5 (*June* 1, 1949).—Microwave techniques are applied to the study of the diffusion of electrons and positive ions in He. For the electron and ion densities realized experimentally, the diffusion takes place ambipolarly; that is, the flow of charged particles of both signs is equalized by the space charge field which they set up. At 1 mm Hg pressure and 0·039 eV average energy, the measured value of the ambipolar diffusion coefficient, D_a, is 540 cm²/sec. The measured variation of D_a with gas density, energy of the particles, and diffusion container size and shape agrees closely with theory. A.

537.533

4816. Second order deflection-focusing of charged particles in homogeneous magnetic fields. HINTENBERGER, H. *Z. Naturforsch.*, **3a**, 669–70 (*Dec.* 1948) *In German.*—An equation is given involving the radii of curvature of the boundaries of a uniform magnetic field, at the points of intersection by the principal ray, which must be satisfied if accurate focusing is to be achieved. Derivation, and discussion of applications will be given later. The formula given is a generalization of those of Hintenberger [*Z. Naturforsch.*, **3a**, 125 (1948)] and Bainbridge [*7th Solvay Congress in Chemistry, Sept.* 21–8, 1947]. J. C. E.

537.533.35 : 621.385.83

4817. A new horizontal electron microscope. DAS GUPTA, N. N., DE, M. L., BHATTACHARYA, D. L. AND CHAUDHURY, A. K. *Indian J. Phys.*, **31**, 497–51 (*Nov.*, 1948).—Technical details and drawings of an experimental laboratory model built in the University College of Science, Calcutta. It uses 3 magnetic lenses giving a max. electron-optical magnification of 20 000; it can operate at up to 80 kV. It is built in demountable sections. Specimen movement by hydraulically operated bellows is claimed to be very smooth in action. No performance results for the microscope are given J. C. E.

537.533.35 : 621.385.83

4818. Phase contrast in electron microscope images

RAMBERG, E. G. *J. Appl. Phys.*, **20**, 441–4 (*May*, 1949).—Image contrast in electron microscope images may arise from absorption, scattering, or phase changes impressed on the illuminating electron wave. In the present paper the intensity distribution in the in-focus and out-of-focus image of an edge of a transparent thin film introducing a prescribed phase change in the incident beam is calculated. It is found that the resulting "phase contrast" increases both with the film thickness (i.e. magnitude of phase change) and with the degree of defocusing and, for thin specimens, exceeds other sources of contrast in magnitude. The model is too schematic to permit a quantitative comparison with measured intensity distributions. A.

537.533.72

4819. Electron flow in curved paths under space-charge conditions. MELTZER, B. *Proc. Phys. Soc., Lond. B*, **62**, 431–7 (*July*, 1949).—A general, synthetic method of obtaining rigorous solutions of steady electron flow subject to space-charge forces is presented. The solutions are not obtained or given boundary conditions, but the boundary conditions are deduced from the solutions. 2 examples of such solutions, involving strongly curved 2-dimensional electron trajectories, are given; the method is in principle capable of giving the solutions of all possible electron flow patterns in 3 dimensions except perhaps those involving intercrossing trajectories. It is suggested that the subject offers scope for applied mathematical research at least on the same scale as potential theory. A.

537.533.74

4820. The scattering of fast positrons and electrons in gold, for the range 0·39–1·1 MeV. LASICH, W. B. *Aust. J. Sci. Res. A*, **1**, 249–60 (*Sept.*, 1948).—The Wilson cloud chamber has been employed with the method of projected angles in a study of the scattering of positrons and electrons in thin Au foil. Small angle scattering is in reasonable agreement with multiple scattering theory. Further, the investigation of large angle scattering gives indications in favour of a spin-orbital interaction, and the absolute intensity of the scattering for positrons and electrons, and their ratio, under these conditions is believed to be absolutely approx. correct, as it is in fair agreement with the theoretical scattering. G. J. K.

537.533.75

4821. On the absorption of 17 MeV electrons in materials of different atomic number. AGENO, M. AND CHIOZZOTTO, M. *Atti Accad. Naz. Lincei (R.C. Cl. Sci. Fis. Mat. Nat.)* **5**, 401–4 (*July–Aug.*, 1948) *In Italian.*—Absorption of a monochromatic beam of 17 MeV electron is made with good geometry in paraffin, Fe, Cd and Pb. It is found that the penetration is greater for small atomic numbers. U. C.

537.533.8

4822. Secondary electron emission and surface structure. EL-SHERBINI, M. A. AND HADDARA, S. R. *Proc. Math. Phys. Soc. Egypt*, **3**, 25–36 (*May*, 1947) *In English.*—An apparatus is described for the investigation of the influence of (*a*) angle of incidence, and (*b*) surface structure on secondary emission due to electron bombardment of targets of Cu, Ag and Ni: the incident electrons could strike the target either normally or at 45°. Different surface structures were obtained by electrolytic deposition on different smooth or roughened bases. It was concluded that the angle of incidence of the electron beam had little effect, but that the arrangement of the atoms in the target surface did influence the magnitude of the secondary emission. F. LL. J.

537.533.9

4823. Space-charge wave amplification effects. HAEFF, A. V. Letter in *Phys. Rev.*, **74**, 1532–3 (*Nov.* 15, 1948).—Consideration of the phenomenon of the interaction between streams of charged particles of different space-charge densities and velocities, indicates a very effective solution to the problem of generation and amplification of energy at mm wavelengths. The principle has been applied to develop special amplifier tubes with gains of 80 db at 3 000 Mc/s having electron currents of only a few mA. It is suggested that such effects as the abnormally intense bursts of solar radio noise associated with sunspot activity, the excess noise in electron beam tubes and magnetrons, the abnormally high temp. of electron clouds in magnetrons, and other effects will find a satisfactory explanation in terms of the phenomenon. W. J. G. B.

537.533.92

4824. Elastic collision cross-section of oxygen atom for slow electron. YAMANOUCHI, T. *Progr. Theor. Phys.*, **2**, 33–7 (*March–June*, 1947) *In English.*—A theoretical curve of cross-section against electron velocity is calculated, and hence the collision frequency of electrons and O atoms in the ionosphere is estimated. P. M. D.

537.534 : 538.244.2 : 621.384.6

4825. Validity of two-dimensional design of synchrotron pole faces. GOWARD, F. K. AND WILKINS, J. J. *Proc. Phys. Soc., Lond.*, **61**, 580–2 (*Dec.*, 1948).—A comparison is made between the 2-dimensional theory of Davy [Abstr. 2501 (1948)] and measurements on 2-dimensional electrolytic tank models and on the magnetic fields of a 30 and a 375 MeV synchrotron. For practical designs Davy's equation for the pole face contour may be replaced by $z = \pm$ constant $\times x^n$, where $z =$ height above central plane, x is the radius vector. In the 30 MeV machine the lip correction for fringing field has an important effect on the slope of the pole face. In the 375 MeV machine the theoretical and 2- and 3-dimensional measurements agree very closely. W. I. B. S.

537.534 : 621.384.6

4826. Some experiments with a 14 MeV betasynchrotron. ALLEN-WILLIAMS, D. J. AND APPLEYARD, R. K. *Brit. J. Radiol.*, **22**, 106–9 (*Feb.*, 1949).—Measurements of beam distribution and absorption in Pb, using Cu as a threshold detector for energies > 11 MeV, are given, and show an asymmetric beam of width about 10° with intensity at max. of 0·2 r/min at 1 m. The calculated neutron flux is $\sim 2 \times 10^5$/sec. Pulse duration measurements and radial spread of the electron beam are also given. F. T. F.

537.534 : 621.396.615 : 621.384.6

4827. Design of the radiofrequency system for the 184 in cyclotron. MACKENZIE, K. R., SCHMIDT, F. H.,

WOODYARD, J. R. AND WOUTERS, L. F. *Rev. Sci. Instrum.*, **20**, 126–32 (*Feb.*, 1949).—A description is given of the frequency-modulated oscillator and its associated r.f. circuits, as used in the 184 in cyclotron for accelerating deuterons to 190 MeV or α-particles to 380 MeV. A 9C21 water-cooled tube is used in a grounded-grid circuit, which is tightly coupled to the single-dee resonant circuit so that the oscillator follows the frequency of the dee over the wide range required. During normal operation the oscillator delivers ~ 20 kW of r.f. power to the dee system at an efficiency of 60%, giving 20 kV at the front of the dee, although the oscillator is capable of considerably more output. The frequency is swept from 12·5 Mc/s to 9·0 Mc/s approx. 100 times per sec by a rotating condenser connected to the dee by a $\lambda/2$ transmission line. Much of the history of the design, and reasons for choices made, are given, as this may be useful to others designing f.m. oscillators for cyclotrons. A.

537.534.74

4828. Angular distribution of 1- to 3·5-Mev protons scattered by He^4. FREIER, G., LAMPI, E., SLEATOR, W. AND WILLIAMS, J. H. *Phys. Rev.*, **75**, 1345–7 (*May* 1, 1949).—The angular distribution of protons scattered by He^4 has been measured in the energy range from 1 to 3·5 MeV and over an angular range of 10° to 164° in the laboratory. The results are given as absolute cross-sections per unit solid angle and show a broad resonance at approx. 2·2 MeV. The values for the cross-sections are considered to be reliable to $\pm 3\%$. A.

537.534.74

4829. *S*-wave proton–proton scattering from 0·2 to 40 Mev for the Yukawa and Gauss error potentials. HATCHER, R. D., ARFKEN, G. B. AND BREIT, G. *Phys. Rev.*, **75**, 1389–98 (*May* 1, 1949).—Tables of the phase shift expected for the *S*-wave in *p–p* scattering are presented. The energy range covered is from 0·2 to 40 MeV. The accuracy obtainable is believed to be sufficient for most applications. For energies < 5 MeV use is made of the function f which varies nearly linearly with energy. Representations of f in terms of depth and range of the potential wells are studied and some questions arising in comparing potentials with each other and with experiment are briefly discussed. A.

537.534.74

4830. The scattering of deuterons by helium at deuteron energies from 0·9 to 3·5 Mev. BLAIR, J. M., FREIER, G., LAMPI, E. E. AND SLEATOR, W., JR. *Phys. Rev.*, **75**, 1678–80 (*June* 1, 1949).—The differential cross-sections for the elastic scattering of deuterons by He have been measured for deuterons of 0·9 to 3·5 MeV over an angular range from 15° to 160° in the centre-of-mass system. The probable error in the absolute values of the cross-sections is $\leqslant 3\%$. For angles $> 60°$ the cross-sections are roughly independent of angle except at 3·5 MeV where they decrease with increasing angle up to 90° and increase beyond. A.

537.534.9

4831. Optical analysis of canal rays. DASANNACHARYA, B. AND DAS, G. K. *Phil. Mag.*, **39**, 966–77 (*Dec.*, 1948).—The Doppler effect of $H\beta$ and $H\gamma$ lines of H canal rays was photographed using a Steinheil 3-prism glass spectrograph. Max. displacements are $\propto$ the velocities of H atoms which are able to traverse the complete discharge space in a charged condition as a singly charged atom, provided the discharge potential is $<$ a certain critical value, 5 500 V for $H\beta$ and 3 500 V for $H\gamma$. The displacements for potentials $>$ these critical values were investigated and the relative prominences in the Doppler effect due to H_{31}, H_{21} and H_{11} atoms were studied. The displacement of the 4 358 Å line of Hg was shown to be due to a singly charged Hg atom accelerated in the cathode fall. L. S. G.

DISCHARGE TUBES . COUNTERS 537.541

537.541

4832. On the construction of Geiger counters and associated electronic circuits. VIGÓN, M. A. AND SEGOVIA, R. *An. Real. Soc. Esp. Fis. y Quim.*, **44**, 686–9 (*Nov.–Dec.*, 1948) *In Spanish.*—On account of the difficulty of construction of amplifiers for proportional counters it was considered more practical to use counters in the Geiger region, when discrimination between types of particles was not needed. Counters are described with a Geiger range extending for about 100 V, near to 1 000 V. The central wire was of W, the cylinder was Ag chemically deposited on glass; the filling was of purified dry air (A not being available) at 4 to 5 cm of Hg, and alcohol for self-quenching. The background count was ~ 30 per min, partly due to photo-effect of Ag. Discharge duration was about $5 \cdot 10^{-4}$ sec. A simple amplifier for earphone detection, for use in the field, is described, as well as integrating and recording circuits of a laboratory equipment incorporating a Neher–Harper extinction circuit. J. C. E.

537.542 : 531.71

Optical method of determining thickness of Geiger tube windows. *See Abstr.* 4505

537.542 : 535.37

Decay times of scintillations. *See Abstr.* 4689

537.542 : 539.16.0

4833. Bibliography: Geiger and proportional counters. HEALEA, M. *Nucleonics*, **1**, 68–75 (*Dec.* 1947).—The first of 3 bibliographies prepared for the Electronics Division of Brookhaven National Laboratory, intended specially for the use of those engaged in instrumentation for nuclear physics. A. P. I.

537.542 : 539.16.0

4834. Bibliography: radiation measurement. HEALEA, M. *Nucleonics*, **2**, 63–5 (*Feb.*, 1948).—See preceding Abstr.

537.542 : 539.16.0

4835. On the measurement of radioactive isotopes. ZIMENS, K.-E. *Trans. Chalmers Univ. Tech., Gothenburg* (*Nr.* 54) 58 *pp.* (1946) *In German.*—An elementary review of the use of electrometers and G–M counters with some consideration of statistical accuracy. A new unit is suggested: the "trans" (= 10^6 disintegrations/min). A. O.

537.542 : 539.165

836. A methane flow beta-proportional counter. ERNSTEIN, W. AND BALLENTINE, R. *Rev. Sci. istrum.*, 20, 347–9 (*May*, 1949).—A CH_4 flow -proportional counter has been designed to detect ie high and low energy solid β-emitters used in acer experiments. At present, both C^{14} and P^{32} re being counted. The use of a sintered-glass Gooch ucible, both as a filter and sample holder, greatly mplifies the analytical technique involved in such periments. The instrument is stable and the results re reproducible over long time periods. A.

537.542 : 539.166

837. A cell-type gamma-counter. BEYSTER, J. R. ND WIEDENBECK, M. L. *Rev. Sci. Instrum.*, 19, 19–20 (*Nov.*, 1948).—Each section of a 12-celled -counter consists of 2 discs, 4 in. in dia. and $\frac{1}{2}$ in part, as cathode, with a central circular ring of W ire, 2 in. in dia., as anode; separate load resistors nd coupling capacitors are used for each cell. The ell is uniformly sensitive over its whole area; the lateau is ~ 100 V, and the starting voltages can be ade equal within 20 V. A 12-section counter is ~ 10 times more efficient than the usual γ-counter. or γ-rays, $\not> 0{\cdot}1$ of the discharges are delayed by $> 0{\cdot}5$ μsec. The background is low. A. O. S.

537.542 : 539.166

838. Experiments in the possibility of increasing he efficiency of gamma-counters. SLÄTIS, H. *Rev. ci. Instrum.*, 20, 353–4 (*May*, 1949).—The efficiency f G–M tubes for recording γ-quanta is increased by nsertion of concentric ring systems of metal between he wire and the cylinder. When the ring systems get uitable voltages, good plateaus and resolving times re obtained. The efficiency of a counter, which had ring systems with 24 rings in each system, was ·5 times that of a conventional counter of the same ize. This means an increase of 6 times in γ–γ-co-ncidence measurements. The efficiency of an im-roved tube is 3·2 times that of a conventional ounter. A.

537.542

839. A study of background rate in Geiger–Müller ounters. PUTMAN, J. L. *J. Sci. Instrum. Phys. Ind.*, 6, 198–201 (*June*, 1949).—A series of experiments is escribed in which the background counting rate of -ray counters is reduced by screening them in Pb to ttenuate local γ-radiation; and by surrounding them ith cosmic ray counters in anti-coincidence to educe the counting rate due to mesons. The normal ackground is reduced by these means by a factor of rom 13 to 17 without impairing the efficiency for -rays. A residual background rate of about 1/20 he normal rate is left unexplained. This is believed o be due to secondary γ-rays produced in the walls f the lead castle by decaying mesons. A.

537.542 : 615.849

840. A mobile Geiger–Müller tube counting ystem and some of its medical applications. TURNER, . C. AND SINCLAIR, W. K. *Brit. J. Radiol.*, 21, 32–7 (*Dec.*, 1948).—The design and operation of a obile counting system capable of reading up to 000 periodic impulses/sec are described. The sensitivity of the instrument is such that it gives full scale deflection for unit tolerance dose-rate of Ra γ-rays and 0·4 tolerance dose-rate for 200 kV X-rays. Accounts are given of its application to the measurement of (*a*) stray radiation in a teleradium treatment and neighbouring rooms, and (*b*) activities in various parts of a patient's body after the administration of radioiodine. C. B. A.

537.542

4841. A simple combined coincidence and anti-coincidence circuit. COOKE-YARBOROUGH, E. H. AND PUTMAN, J. L. *J. Sci. Instrum. Phys. Ind.*, 26, 240–1 (*July*, 1949).—A simple circuit is described which is capable of recording simultaneously the coincidences and anti-coincidences between pulses from 2 sources. The circuit could be extended to record various combinations of coincidences and anti-coincidences between pulses from a number of sources. A.

537.542 : 621.317.757

4842. A distribution analyser for lengths of impulses. GARFIELD, O. R. *Bell Lab. Rec.*, 26, 325–30 (*Aug.*, 1948).—An apparatus to record a 10-point cumulative distribution curve of the length and relative frequency of occurrence of irregularly recurring phenomena. P. O. (R)

537.542 : 621.389

4843. Electronic equipment for Geiger–Müller counters. HARBER, H. *Forsvarets ForsknInst. Årb.*, 24–38 (1947) *In Norwegian.*—Descriptions and diagrams are given of amplifier couplings for impulse amplification, mains-driven stabilized rectifiers for h.t. supply, single-step amplifiers using thyratron and mechanical count-recording, frequency divider (Eccles–Jordan multivibrator) and impulse amplifier, for use with small 700–900 V counters in connection with material testing by β- and γ-rays. The properties of the various circuits are discussed and the assembly is described. J. A. W. (R)

IONIZATION . THERMIONICS 537.56/.58

537.56

4844. Secondary processes of ion production in the mass spectrometer. MITCHELL, J. J., PERKINS, R. H. AND COLEMAN, F. F. Letter in *J. Chem. Phys.*, 16, 835–6 (*Aug.*, 1948).—The secondary production of HCO_2^+ in a mass spectrometer was investigated by adding H or H_2O to CO_2 admitted into the ion source. Appreciable changes in the 45 : 44 intensity ratios were observed, with ion source pressure $\sim 5 \cdot 10^{-4}$ mm Hg. T. G. P.

537.56

4845. A comparison of the ionization cross-sections of H_2 and D_2. HONIG, R. E. Letter in *J. Chem. Phys.*, 16, 837–8 (*Aug.*, 1948).—Sensitivities of H_2^+, D_2^+ were studied in a mass spectrometer against pump temp. and ion accelerating voltage E^+. Poor pumping efficiency at normal temps. caused fluctuations in sensitivity, which disappeared at higher temps., and similarly a region of E^+ was found where sensitivity

was little affected by substantial changes in E^+. With these conditions, $H_2^+/D_2^+ = 0{\cdot}96_1 \pm 0{\cdot}005$, for 50 V electron energy. It is concluded that ionization cross-sections of H_2^+, D_2^+ (and probably HD^+) are the same within 4% and that ion currents are $\propto$ partial pressure in the reservoir, not to flow rate, and no mass corrections should be made.

T. G. P.

537.566 : 536.46

Ionization flame detectors. *See Abstr.* 4731

537.567 : 536.752

The entropy of gaseous mixtures in ionization equilibrium. *See Abstr.* 4746

537.58

4846. Thermionic and photoelectric emission with moderate applied electric fields, employing a two-step potential barrier. JACOBI, T. H. *Phys. Rev.*, **75,** 1599–601 (*May* 15, 1949).—Presents a theoretical analysis of electron emission, both thermionic and photoelectric, with moderate applied electric fields, based on a 2-step potential barrier. An expression is obtained for thermionic emission current density with applied electric field containing 2 arbitrary constants, V_1 and a, the height and width of the first step of the barrier. Comparison of this expression with the experimental results of Phipps and Seifert [Abstr. 4424 (1939)] yields reasonable values for these constants. An expression is obtained also for photoelectric emission employing the same barrier shape in which insertion of the same values of V_1 and a results in a periodic deviation of photo-current with applied electric field. The present theoretical results for the photo-current *v.* applied electric field are compared with those of Guth and Mullin [Abstr. 1354, 1933 (1941)]. A.

537.581

4847. Anomalous values of the thermionic emission constant. IVEY, H. F. Letter in *Phys. Rev.*, **74,** 983–4 (*Oct.* 15, 1948).—Attention is drawn to fact that recent measurements of constant A of the Richardson–Dushman equation are $\ll$ those previously accepted in the supposed anomalous cases of Ni, Pt and Zr. For instance, Wahlin [Abstr. 1835 (1942)] found $A = 30$ for Ni, instead of as previously 1 830, Whitney [Abstr. 949 (1937)] found $A = 32$ for Pt (instead of 17 000), and present experiments found $A = 120$ for Zr instead of 330. Complicated theoretical arguments to explain anomalously high values of A are no longer necessary [see Abstr. 1265 (1948), 4848 (1949)], but explanation of experimental values of $A <$ the theoretical 120 is still necessary.

F. LL. J.

537.581

4848. Anomalous values of the thermionic emission constant. WOHLFARTH, E. P. Letter in *Phys. Rev.*, **74,** 984–5 (*Oct.* 15, 1948).—Discusses comparison of experimental determinations of the constant A [see Abstr. above] and theoretical calculation; extreme cleanliness of surface and purity of metal are important owing to their unpredictable influence on thermionic emission. Until these effects are understood no satisfactory comparison of theoretical and experimental results can be made. F. LL. J.

COSMIC RAYS 537.591

537.

4849. An apparatus for use with cosmic ray counte I. Description. FRÉON, A. AND MAZE, R. *J. Ph Radium* (*Sér.* 8) **9,** 301–4 (*Dec.*, 1948) *In French.*— description is given of a set of multiple coincide tubes, with a mechanical hodoscope recording o strip of paper, for use in aircraft. U

537.

4850. Measurements of the absolute intensity cosmic radiation at sea level. MONTGOMERY, R. *Phys. Rev.*, **75,** 1407–12 (*May* 1, 1949).—A cosmic- telescope is described which measures the absol intensity of the radiation through the use of trays overlapping Geiger counters to eliminate insensit areas. The results obtained, carefully corrected accidentals, counter efficiency, side showers, absc tion and barometric pressure, are compared w those of previous authors.

537.

4851. The properties of cosmic radiation in lower atmosphere. POMERANTZ, M. A. *Phys. Ra* **75,** 1721–8 (*June* 1, 1949).—Experiments perfor previously with apparatus carried to very h altitudes by free balloons have been conducted in lower portion of the atmosphere. 2 different inst ments were operated in a B-29 aeroplane, and at Evans, Colorado. Absorption curves in Pb, up t thickness of 18 cm, were obtained at 14 26(25 000 ft and 30 000 ft. Intensity *v.* altitude cur for the lower regions of the atmosphere may now combined with those for very high altitudes with an arbitrary normalization. A direct comparison been made between the present measurements those of others regarding the relative change intensity between sea level and Mt. Evans, and absorption in Pb at Mt. Evans. Factors for conversion of all of the data to absolute intensi have been determined utilizing a γ-ray howit method for measuring the effective length of a G counter. Satisfactory agreement is noted betw values of the absolute intensity previously measu by others at sea level and at Mt. Evans, and th reported herewith. The absolute intensity of cosm ray particles near the "top of the atmosphere" geomagnetic latitude 52° N is given as $10{\cdot}1 \pm 0$ particles/min/cm²/unit solid angle. Consideratio given to the considerable error which may be in duced in the comparison of measurements of "total" intensity at very high altitudes obtained v different G–M counters.

537.5

4852. On the origin of cosmic rays. RICHTM R. D. AND TELLER, E. *Phys. Rev.*, **75,** 1729–31 (*J* 1, 1949).—The presence of heavy particles in cos rays makes it plausible that cosmic radiation generated by the acceleration of charged particle extended e.m. fields. The energy density of cos rays ($3 \times 10^{-10}\ Mc^2/cm^3$) would lead to very g total amounts of energy if one assumes that cos radiation extends throughout intergalactic or in stellar space. This would require very effic methods of cosmic-ray production. It is therefor interest to investigate the possibility that cosmic

are generated in the vicinity of the sun and are confined to the solar system by extended magnetic fields. The strength of these fields is estimated to be 10^{-5} gauss. According to this picture, cosmic rays circulate in the neighbourhood of the planetary system for thousands of years, during which time the radiation becomes isotropic. The electron component of the radiation is eliminated by collisions with solar light quanta. A.

537.591.1

4853. On the solar origin of cosmic radiation. ALFVÉN, H. *Phys. Rev.*, **75**, 1732–5 (*June* 1, 1949).—It is shown that motion of interstellar matter is likely to amplify a primary interstellar magnetic field up to the value of the order 10^{-5} gauss postulated by Richtmyer and Teller [preceding Abstr.]. According to an earlier suggestion, magnetic storm variations of cosmic radiation are due to electric fields set up within the solar system by the storm-producing beams. It is shown that the long-time effect of the same mechanism may account for the generation of cosmic radiation. It is of special interest that there seems to be some hope to derive theoretically the observational energy spectrum. A.

537.591.1 : 539.18

4854. Neutral mesotrons in cosmic rays? TRUMPY, B. AND BJORDAL, T. *Bergens Museums Årb.* (*No.* 5) 1–11 (1942) *In English.*—Concludes that the majority of the observations that have been reported in support of the existence of a neutral meson component of cosmic rays, may in fact be interpreted in terms of the scattering of charged mesons. A series of observations illustrating the importance of scattering in experiments designed to record a neutral cosmic ray component with a system of counters, is reported. E. P. G.

537.591.15

4855. On the theory of air shower initiated by secondary soft rays. HAYAKAWA, S. AND TOMONAGA, S. Letter in *Progr. Theor. Phys.*, **2**, 161–2 (*July–Oct.*, 1947) *In English.*—The derivation of extensive air showers from proton cosmic ray primaries, by photon emission at the transition proton to neutron (with the emission of mesons), is considered. If the cross-section for meson formation is of the order $\pi(\hbar/\mu c)^2$, the cross-section for photon emission is large enough to agree with the observed density-frequency relation for extensive showers. J. G. W.

537.591.15

4856. Penetrating power of extensive shower particles. REYNOLDS, G. T. AND HARDIN, W. D. Letter in *Phys. Rev.*, **74**, 1549–50 (*Nov.* 15, 1948).—Coincidences of 6 counter trays under Pb shielding up to 30 cm thick with 2 unshielded master trays were used to determine the penetrating power of extensive showers. After a slight transition effect in 2 cm Pb, the proportion of counts under Pb decreased steadily to 15 cm Pb (1 count in 17 remaining) at which thickness a strong change of absorption was noted. 2 components, responsible respectively for penetration up to and beyond 15 cm Pb, are deduced. J. G. W.

537.591.15

4857. Properties of penetrating particles in Auger showers. DAUDIN, J. *C.R. Acad. Sci., Paris*, **227**, 1094–6 (*Nov.* 22, 1948) *In French.*—Two counters in a common cavity shielded with 19 cm Pb, in coincidence with an extended unshielded array, at sea level and at Pic du Midi (2 860 m) showed 35%–40% coincidences between the shielded counters. When with unchanged geometry each of these counters was wrapped in 0·4 cm Pb sheet the coincidence rate was reduced by 40%. The presence of a penetrating element followed by actual shower particles which are soft is in accord with the postulate of a particle of mass intermediate between that of electron and μ-meson. J. G. W.

537.591.15

4858. Investigation of kindred impulses by means of proportional counters. DOBROTIN, N. A., STASHKOV, G. M. AND TSIRLIN, V. YU. *Dokl. Akad. Nauk, SSSR*, **65** (*No.* 4) 473–6 (1949) *In Russian.*—Simultaneous impulses observed during the Pamir expeditions, 1946 and 1947, which could not be explained by the passage of ordinary showers through a group of proportional counters, were more closely investigated in 1948, using a more elaborate set-up. The latter consisted of a "telescope" comprising 2 counter groups, and a "hodoscope" group of rapid counters. Analysis of the experimental data results in a clear separation of the coincidences due to wide showers from those of other types of showers, by means of the marked differences in the correlation coefficients of the impulses, and also comparison with the data obtained by ionization chamber methods. The total number of showers registered by the new set-up exceeds the number of showers registered by multiple coincidences 2–3 times. The first kind of coincidences is due to heavily ionizing particles, for which there is no correlation between the impulse values. These particles, in turn, cannot be produced by heavily ionizing particles such as originate in nuclear disintegrations of the known kind. The second category of coincidences is due to showers of relativistic particles, thus mainly to the wide atmospheric showers. In these heavily ionizing particles are conspicuous. B. F. K.

537.591.15

4859. Theoretical analysis of ionization chamber data on large air showers. BLATT, J. M. *Phys. Rev.*, **75**, 1584–98 (*May* 15, 1949).—The decoherence curve of large air showers is analysed under the simplifying assumption of a constant lateral structure function for all air showers. The following results emerge: (1) Contrary to statements found in the literature, ordinary shower theory leads one to expect a rise in the decoherence curve at distances $\ll$ the characteristic lateral distance r_1. (2) The theoretical decoherence curve calculated under the assumption of a constant structure function rises *more* sharply near the origin than the experimental points. This indicates that the effective structure function is less peaked than the one used (due to Molière). (3) The dependence of the structure function upon the age of the shower tends to lessen this discrepancy. However, quantitative estimates make it appear doubtful that one can get agreement between theory and experiment without assuming a rather high multiplicity of the event which starts the shower. A.

537.591.15 : 539.18

4860. Some considerations about the production of meson showers in matter. TOMONAGA, S. Letter in *Progr. Theor. Phys.*, **2**, 90–1 (*March–June*, 1947) *In English.*—Since Heitler's theoretical figure for meson production is several times the square of the range of nuclear forces, it is concluded that meson production must be multiple. The bearing of this on observations of bursts and penetrating showers is briefly discussed. E. P. G.

537.591.15 : 539.185

4861. Analysis of neutrons in extensive showers. LEVINGER, J. S. *Phys. Rev.*, **75**, 1540–3 (*May* 15, 1949).—Cocconi Tongiorgi has shown [Abstr. 4862 (1949)] that there are neutrons in cosmic-ray extensive showers, and that some are produced locally, while some are present in the atmosphere. In this paper the experimental measurements are analysed into elementary factors: the transmission of the neutrons through paraffin, the production of neutrons in paraffin, the production of neutrons in Pb, the transmission of neutron producers through paraffin, the transmission of neutron producers through Pb, and neutrons present in the atmosphere. It is found that the neutrons detected have a transmission corresponding to a mean energy of ~ 3 MeV. In the arrangement of neutron counters in paraffin, the counting rate due to local neutron production in the paraffin is comparable to the counting rate due to neutrons in the atmosphere. These results are in agreement with those of Cocconi Tongiorgi. A.

537.591.15 : 539.185

4862. Neutrons in the extensive air showers of the cosmic radiation. COCCONI TONGIORGI, V. *Phys. Rev.*, **75**, 1532–40 (*May* 15, 1949).—Neutrons associated with extensive air showers have been studied by recording delayed coincidences among G–M counters and proportional BF_3 counters. The experiments have been performed at 260, 3 260 and 4 300 m above sea level. It has been shown that in the extensive showers both neutrons of moderate energies and radiations capable of producing such neutrons are present. The number of neutrons and neutron-producers in showers of different sizes is roughly $\propto$ the number of the electrons. The neutron-producers cannot be, at least in a large fraction, either electrons, or photons, or μ-mesons. Nuclear interactions induced by fast neutrons and protons are consequently thought to give the main contribution to the neutron production observed. The total neutron-producing-radiation is of the order of 2–3% of the electronic component of the showers at 3 260 m. Its altitude variation is consistent with the assumption that nucleons constitute its main component. The multiplicity of the neutron production in Pb is very high: ~ 60 neutrons of energies between 2 and 15 MeV are produced at a time on the average. A.

537.591.3

4863. Cosmic-rays underground. HAYAKAWA, S. Letter in *Progr. Theor. Phys.*, **3**, 199–200 (*April–June*, 1948) *In English.*—The change in exponent of the absorption of the cosmic ray beam in the earth at a depth of 400 m H_2O equivalent is treated as a result of the range of decay of heavy mesons to light mesons. The estimate of 5×10^{-8} sec for the lifetime of t heavy meson follows. J. G.

537.591

4864. Note on the collision energy of fast charg particles. NAKABAYASI, K. *Progr. Theor. Phys.*, 82–94 (*Jan.–March*, 1948) *In English.*—The Blo formula is obtained by a semi-classical meth assuming dipole excitation of the atoms. The effec of spin and finite mass are included and the formu related to cosmic ray data. G. J.

537.591

4865. On the variation of the barometer effect the hard cosmic ray component with zenith angl TRUMPY, B. AND ORLIN, J. *Arch. Math. Naturwidens B*, **44** (*No.* 9) 8 *pp.* (1941) *In English.*—Measuremen showing an increasing barometer coeff. for the ha component with increasing zenith angle are reporte The results are discussed in terms of meson dec and the combined effects of atmospheric temp. a pressure distributions. E. P.

537.591

4866. The energy-spectrum of the hard cosmic r component in different directions and the life-time the mesotron. TRUMPY, B. AND V. UBISCH, H. *Arc Math. Naturwidensk. B*, **44** (*No.* 12) 16 *pp.* (1941) *English.*—An improved form of the meson ener spectrum is given for arbitrary direction from t vertical. This is compared with cloud chamber a absorption experiments of various workers. T meson lifetime deduced is $2{\cdot}3 \times 10^{-6}$ sec. E. P.

537.591

4867. On the temperature effect of undergrou cosmic radiation. MIYAZIMA, T. Letter in *Prog Theor. Phys.*, **3**, 99–100 (*Jan.–March*, 1948) *English.*—The reported positive temp. coeff. of cosm ray intensity underground is considered as arisi from the increased path length of π mesons in a (these being assumed to be capable of ranges of t order of the atmospheric thickness), allowing larger number of energetic μ-mesons to be form by π–μ decay in the atmosphere when air tem increases. J. G.

537.591

4868. Zenith angle distribution of the penetrati component of cosmic rays. ROGOZINSKI, A. A VOISIN, A. *C.R. Acad. Sci., Paris*, **227**, 1092 (*Nov.* 22, 1948) *In French.*—Apparatus alrea described [Abstr. 4076 (1949)] has been develop to determine the zenith angle variation of the pen trating component at Meudon (148 m altitude) for 14 and 22 cm Pb absorbers. No difference of vari tion among these thicknesses was detected, and t variation is of the form $I(\theta) = I(o)\cos^n\theta$, whe $n = 2{\cdot}20 \pm 0{\cdot}06$. Differential range measuremen show no significant zenith angle effect. J. G.

537.591

4869. The intensity of heavily ionizing penetrati particles at 4 300-meter altitude. HEREFORD, F. *Phys. Rev.*, **75**, 923–8 (*March* 15, 1949).—The counti efficiency of a low pressure G–M counter for t ionizing cosmic radiation penetrating various thic nesses of Pb has been measured at 4 300 m altitud From existing data it is possible to determine t

counting efficiency expected for mesotrons alone at that altitude. For thicknesses > 100 g/cm² electrons are excluded, and the observed excess in counting efficiency over that expected for mesotrons can be interpreted as due to heavily ionizing particles. On the assumption that these are protons the data indicate, for example, that 17 ± 5% of the radiation penetrating 167 g/cm² Pb consists of protons. A.

537.591.8 : 539.18

4870. The energy spectrum of the decay particles and the mass and spin of the mesotron. LEIGHTON, R. B., ANDERSON, C. D. AND SERIFF, A. *Phys. Rev.*, **75**, 1432–7 (*May*, 1949).—Energy values determined from curvature measurements of 75 cloud-chamber tracks of decay particles of cosmic-ray mesotrons at sea level, in a magnetic field of 7 250 gauss, are here reported. The observed spectrum extends from 9 MeV to 55 MeV with an apparently continuous distribution of intermediate energy values and a mean energy of 34 MeV. The shape of the spectrum and the value of its upper limit are strong evidence that the mesotron disintegrates into an electron and 2 neutrinos. It is concluded that the mesotron has ½-integral spin. The value of the observed upper limit of the energy spectrum corresponds to a mass value of the mesotron equal to 217 ± 4 m_e. A.

537.591.8 : 539.18

4871. The mass of cosmic-ray mesotrons. RETALLACK, J. G. AND BRODE, R. B. *Phys. Rev.*, **75**, 1716–21 (*June* 1, 1949).—By cloud-chamber observations of the curvature of mesotrons in a magnetic field of 4 750 gauss and the subsequent range of these same particles in a second cloud chamber containing 15 Pb plates each 0·67 cm in thickness, the mass of 43 cosmic-ray particles has been determined. 37 of these particles appear to give a set of observations that are consistent with a unique mass of 215 ± 4 times the mass of an electron. Of the 6 remaining observations 4 indicate a mass much too large (474, 538, 588 and 717) to be reasonably considered as statistical fluctuations in the observations of normal mesotrons. The remaining 2 observations (114 and 120) also appear to be inconsistent with the normal mass of the mesotron and the observed probable errors in individual measurements in this experiment. A.

MAGNETISM 538

538 : 523.73

Solar magnetism and the suggested fundamental magnetization by rotation. *See Abstr.* 4413

538.082

4872. The measurement of magnetic susceptibility at low temperatures. GIAUQUE, W. F., FRITZ, J. J. AND LYON, D. N. *J. Amer. Chem. Soc.*, **71**, 1657–64 (*May*, 1949).—A fluxmeter for measuring the reversible adiabatic magnetic susceptibility in the presence of large fields has been devised and tested. Equations relating the observed magnetic induction to the susceptibility of the sample have been given. Cd–Zn solder has been suggested for use in magnetic apparatus at the temperature of liquid He where the superconductive properties of ordinary solder are objectionable if sensitive measurements are desired. A.

538.082.1

4873. Multipoint recording with a pen recorder applied to magnetic measurements. ALLRED, H. M. *Rev. Sci. Instrum.*, **19**, 818–19 (*Nov.*, 1948).—To obtain curves connecting susceptibility with temp. a sample is mounted in the field of an electromagnet on the arm of a torsion balance, which is maintained undeflected by applying an adjustable restoring torque. By means of cam-driven micro-switches a pen recorder is arranged to record alternately voltages from a thermocouple measuring the temp. and from a helical potentiometer providing a voltage ∝ the restoring torque and hence to the susceptibility of the sample. Corresponding points on the 2 curves give the susceptibility-temp. curve. C. E. W.

538.082.103 : 621.317.44

4874. A simple direct-reading fluxmeter. BRIGGS, J. H. AND MITCHELL, W. H. *J. Sci. Instrum. Phys. Ind.*, **26**, 40–2 (*Feb.*, 1949).—A description of a new type of fluxmeter incorporating a soft iron movement, which is extremely simple and robust, is direct reading, and requires no external connections. It can be adapted for measurement of the flux densities of variously shaped magnets to an accuracy of 2%. A.

538.114

4875. On the alloy theory of ferromagnetism. YOSIDA, K. AND MIYAHARA, S. *Progr. Theor. Phys.*, **3**, 74–81 (*Jan.–March*, 1948) *In Esperanto*.—The authors compare the Heisenberg–Bloch theory of ferromagnetism and a theory in which the ferromagnetism is considered as produced by an alloy of + and − spins, similar to Tagaki's theory of a two-element alloy. The two partition functions are constructed and the energy distributions compared. R. B. S.

538.22

4876. Magnetic properties of solids. I. Magnetic properties of non-ferromagnetic bodies. KLEMM, W. AND VOGT, E. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 1–26 (1948) *In German*.—The methods of measurement, especially with a suspended cylinder, are reviewed. The various types of magnetic phenomena are described with reference to the wartime German work on many classes of solid, e.g. nitrides of metals, complex organic and inorganic materials, certain elements, condensed gases, metals and alloys. The effects of impurities and structural flaws on the values of susceptibilities found experimentally are investigated and reference is made to the extensions of the "gas" theories of magnetism. For the more complex solids the effects of valency bond directions or the spin orientations of outer shell electrons are explained. C. A. H.

538.22

4877. Magnetism and the third law of thermodynamics. Magnetic properties of ferrous sulfate heptahydrate from 1 to 20°K. Heat capacity from 1 to 310°K. LYON, D. N. AND GIAUQUE, W. F. *J. Amer. Chem. Soc.*, **71**, 1647–57 (*May*, 1949).—The heat capacity of ferrous sulphate heptahydrate has been measured from 0·9 to 307°K. The entropy,

less nuclear spin and isotopic contributions, has been calculated to be $97{\cdot}8 \pm 0{\cdot}3$ cal. deg.$^{-1}$ mole^{-1} at 298·16°K. The initial magnetic susceptibility of ferrous sulphate heptahydrate has been measured between 0·84 and 20°K. The temp. change accompanying adiabatic magnetization has been measured in fields to 8 500 oersteds and over the range 0·84 to 18°K. The magnetization and demagnetization of ferrous sulphate heptahydrate have been shown to be highly reversible processes. The adiabatic differential magnetic susceptibility has been measured over the range 0·86 to 11°K and at various fields up to 8 500 oersteds. The heat capacity data and the temp. change during magnetization have been used to calculate the entropy change accompanying isothermal magnetization. Values of this quantity have been used, in combination with thermodynamic relationships, to evaluate the temp. coefficient of magnetic susceptibility. A curve of the initial magnetic susceptibility calculated by integrating the temp. coefficient of susceptibility is in complete agreement with the directly measured values. The portion of the total heat capacity due to the electronic system has been estimated by comparing the data with the heat capacity of the diamagnetic zinc sulphate heptahydrate. Near the liquid He temp. region the rather considerable heat capacity is almost completely due to the electronic system. The relationship between the observed heat capacity and the electronic energy pattern responsible for it has been discussed. The heat capacity of Pyrex glass below 20°K has been estimated as $1{\cdot}07 \times 10^{-6} T^3$ cal. g.$^{-1}$ deg.$^{-1}$. A.

538.221

4878. Magnetic properties of solids. II. Ferromagnetism. BECKER, R. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, II*," 27–42 (1948) *In German.*—The many advances of the general theory of ferromagnetism originally formulated by Weiss and Heisenberg are recorded. A discrepancy in the general theory concerning the variation of lattice constant, and hence volume, with magnetic field has been explained by Kornetzki. C. A. H.

538.221

4879. Natural and induced ferromagnetic resonance. BIRKS, J. B. Letter in *Phys. Rev.*, **74,** 988 (*Oct.* 15, 1948).—Measurements have been made of the complex permeabilities of several ferromagnetic compounds. It is shown that anomalous g values previously reported [Abstr. 2938 (1947), 3384 (1948)] are due to an internal field acting on the specimen. A. E. DE B.

538.221

4880. Ferromagnetic resonance at microwave frequencies in an iron single crystal. KIP, A. F. AND ARNOLD, R. D. *Phys. Rev.*, **75,** 1556–60 (*May* 15, 1949).—This has been observed at 23 675 and 9 260 Mc/s, using an external magnetic field applied perpendicular to the r-f magnetic field in the plane of the crystal surface. A variation in the resonance field is found which depends on the angle the magnetic field makes with the crystal axes. The results agree well with the theory of Kittel which predicts that an angular variation in resonance will result from the effects of crystal anisotropy. In the case of the lower frequency, deviations from the expected angular variation and a second resonance peak are shown to be the result of incomplete alignment of the magnetization with the direction of applied field. A calculation of the first-order anisotropy constant computed on the basis of this deviation agrees well with the known value.

538.22

4881. Investigation of the magnetic properties of chromium tellurides. GALPERIN, F. M. AND PERKALINA, T. M. Letter in *J. Exp. Theor. Phys. USSR,* **19** (*No.* 5) 470–2 (*May*, 1949) *In Russian.*—The tests were made at room temperature and at that of liquid N (− 196° C), the field being taken to a maximum of 7 500 oersted. The alloys contained Te in concentrations from 1 to 70 atomic %. Ferromagnetic character was exhibited for a Te content of 1%. Maximum of magnetic saturation was observed at 50 atomic % Te. The values obtained for this alloy are very much higher than those observed by Guillaud [*C.R. Acad. Sci., Paris,* **222,** 386, 1224 (1946)], viz. 314 gauss at room temp. and 447 at −196°C, against 74·57 gauss of Guilland's data. The field strength for obtaining saturation are much higher at lower temperatures. B. F. I

538.221 : 537.311.3

The ferromagnetism of semi-conductors. *See Abstr.* 4788

538.22

4882. Paramagnetism of single crystals of the salts of the iron group of elements at low temperatures. Part II. Inversion of the Stark patterns for six-co-ordinated Ni^{++} and Co^{++} ions and for four- and six-coordinated Co^{++} ions. BOSE, A. *Indian J. Phys.* **22,** 276–90 (*June*, 1948).—The comparison of experimental magnetic data with the conclusions of crystalline electric field theory made in Part I for the relatively simple Ni^{++} and Cr^{+++} ions [see Abstr. 3830 (1948)] is extended to the more complicated case of the Co^{++} ion. The theory shows that in a given field the Stark pattern of the ground state of the Co^{++} ion is inverted with respect to that of the Ni^{++} ion. Since the sign of the cubic field constant is opposite for 4-co-ordinated and 6-co-ordinated ions, Co^{++} salts, 4-co-ordinated Co^{++} salts should behave magnetically similarly to 6-co-ordinated Ni^{++} salts. Measurements of the temp. variation of anisotropy and of effective moments between 300° and 80° confirm this conclusion. For 6-co-ordinated Co^{++} salts the conditions are more complex, but a considerable measure of consistency between theoretical and experimental results has been established. C. E. W.

538.22

4883. Magnetic determination of the constitution of paramagnetic alloys application to cerium-magnesium alloys. MAHN, F. *J. Rech. Cent. Nat. Rech. Sc.* (*No.* 7) 144–55 (1948) *In French.*—Apparatus for preparing the alloys by fusion under A is described. Curves of measured susceptibility χ versus concentration agree well with Vogel's phase diagram [*Z. Anorg. Allgem Chem.*, **91,** 277 (1915)]. Definite compounds $CeMg_9$, $CeMg_3$ and CeMg are indicated by a change of slope or maximum of the curve. From measurements at different temps. the paramagnetic Curie point Θ, Curie constant C and magn

moment are determined. At low temp. curves of Θ versus C and of Θ versus concentration show characteristic features. Each of the above compounds has its own Curie point. The mixture of two insoluble phases $Mg + Mg_9$ shows the Θ of the latter, while the variation of χ with concentration is linear. Eutectic mixtures are not revealed by this magnetic analysis as distinct from mechanical mixtures. H. M.

538.222

4884. Paramagnetic absorption in single crystals of copper sulfate pentahydrate. WHEATLEY, J. AND HALLIDAY, D. *Phys. Rev.*, **75**, 1412–15 (*May* 1, 1949).—Paramagnetic resonance in $CuSO_4 . 5H_2O$, at 9 375 Mc/s has been studied. Although 2 absorption peaks were expected, only one was found; Van Vleck has explained this in terms of exchange coupling between Cu^{++} ions. Electronic gyromagnetic ratios for a large number of orientations of the crystal (with respect to the external field) have been found. Theory agrees with experiment if the gyromagnetic ratios that correspond to the 3 principal susceptibilities are 2·39, 2·39 and 2·07. A variation in absorption line width with orientation is also found. The shapes of the absorption lines agree with a theory of exchange coupling advanced by Gorter and Van Vleck. A.

538.222 : 536.48

4885. Some problems of paramagnetism. GORTER, C. J. *Experientia*, **4** (*No.* 12) 453–65 (1948) *In French.*—A review of the subject, noting the phenomena of paramagnetic relaxation and resonance. Experimental technique in the radio and u.h.f. ranges is described. The production of low temps. by adiabatic magnetization is described, and attempts to align atomic nuclei at these temps. is noted. N. F. A.

538.224

4886. Diamagnetic susceptibilities of some chloro and fluoro derivatives of methane and ethylene. LACHER, J. R., SCRUBY, R. E. AND PARK, J. D. *J. Amer. Chem. Soc.*, **71**, 179–97 (*May*, 1949).—An apparatus is described for measuring the susceptibilities of liquids under pressure Diamagnetic susceptibilities of the following compounds were determined: CCl_3F, CCl_2F_2, $CHCl_2F$, $CHClF_2$, $CCl_2 = CCl_2$, $CCl_2 = CHCl$, $CCl_2 = CH_2$, $CHCl = CHCl$ *cis* and *trans*, $CHCl = CH_2$, $CCl_2 = CClF$, $CCl_2 = CF_2$ and $CClF = CF_2$. The data give, by extrapolation, an estimate of the susceptibilities of the following compounds: $CClF_3$, CF_4, CHF_3, C_2H_4 and C_2F_4. The relationship of the data obtained to Pascal's constants is discussed. It was found that *trans*-dichloroethylene and vinylidene chloride have measurably lower susceptibilities than the corresponding *cis*-isomer. A.

538.244.2 : 621.384.6 : 537.534

Design of synchrotron pole faces. *See Abstr.* 4825

ELECTROMAGNETISM
ELECTRODYNAMICS 538.3/.5

538.3

4887. Boundary and discontinuity problems of the Maxwell equations. LEDINEGG, E. *S.B. Öst. Akad. Wiss., Abt. IIa*, **156** (*Nos* 7–8) 417–40 (1948) *In German.*—A new discussion of these problems is given, and it is shown that in the case of an enclosure with perfectly conducting walls the solutions may be specified by two integral equations. P. M.-D.

538.3

4888. Non-linear theories of the electromagnetic field. BERTEIN, F. *Rev. Sci., Paris*, **86**, 349–56 (*April*, 1948) *In French.*

538.3

4889. The experimental basis of electromagnetism. III. The magnetic field. CAMPBELL, N. R. AND HARTSHORN, L. *Proc. Phys. Soc., Lond. A*, **62**, 422–9 (*July*, 1949).—The principles outlined in previous parts [Abstr. 108 (1947), 961 (1948)], which dealt with the direct current circuit and with electrostatics, are here applied to magnetism, with the object of showing how the basic concepts are defined in terms of the operations actually performed in measuring them. This part is confined to a discussion of the vector B, which is shown to be measurable independently of a knowledge of any other magnitude. It is solenoidal, and can therefore be determined at all points, even those within solid bodies. A.

538.3

4890. The experimental basis of electromagnetism. IV. Magnetic materials. HARTSHORN, L. *Proc. Phys. Soc., Lond. A*, **62**, 429–45 (*July*, 1949).—Concludes the inquiry which was undertaken with the object of elucidating the connection between the concepts and principles of electromagnetism and the experimental operations actually performed in the laboratory that constitute their factual basis. In Part III the vector B was established as measurable everywhere, even within solid bodies. The vector H and the scalar $\mu = B/H$ are now shown to be measurable in special circumstances by means of the magnetometer and permeameter, but in general their values depend on a hypothesis, which is stated. The significant facts concerning the magnetic properties of real materials are briefly reviewed, and the two-fold aspect of the science is emphasized: the self-consistent mathematical theories based on postulates, on the one hand, and the complex of experimental laws on the other. [See preceding Abstr.] A.

538.3

4891. Integral formulation of the electromagnetic laws in space-time. FINZI, B. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 203–11 (*Nov.*, 1948) *In Italian.*

538.31

4892. Developments in the correction of magnetic compasses. HARVEY, G. N. *Engineering*, **166**, 505–7 (*Nov.* 26); 529–31 (*Dec.* 3, 1948).—Describes the correction by the use of field coils of magnetic compasses for deviating forces due to permanent and induced magnetism in the ship's hull. The field coils are supplied with current controlled by 8 potentiometers driven from a cam contoured according to a truncated Fourier series which arises in the theory. Automatic correction on all headings is given in regions of constant H and dip, but resetting is necessary for changes in magnetic lattiude. Correction of heeling errors by the use of permanent magnets is also discussed. N. F. A.

538.32

4893. The motion of an electrified particle in the magnetic field of a current. BRUNEL, A. *Rev. Sci., Paris*, **86**, 345–7 (*April*, 1948) *In French.*

538.566

4894. A microwave polarimeter. SCHWANEKE, A. E. AND HARVALIK, Z. V. *Rev. Sci. Instrum.*, **20**, 337–41 (*May*, 1949).—A microwave polarimeter is described which enables the determination of rotation of the plane of polarization of microwaves in the 3·2 cm band. The microwaves are fed into a horn which acts as a polarizing agent. The analyser-receiver consists of a horn radiator, rotatable waveguide, a crystal detector and an indicator. Changes of angles of rotation can be detected if they are $\lessgtr$ than 2° to 3°. A.

538.566 : 621.396.611.4

4895. Perturbations and the pressure of radiation in electromagnetic cavities. KAHAN, T. *C.R. Acad. Sci., Paris*, **223**, 785–6 (*Nov.* 13, 1946) *In French.*—A formula established previously [Abstr. 2423 (1946)] is used to calculate the relative change in resonant frequency of a resonator which either changes its shape slightly or is modified by the introduction of small pieces of metal. Under certain conditions the formula may be written in the form $\delta\omega/\omega = W^{-1}\int_{\delta V} P\,dV$, where P is the pressure of the radiation. Two applications are made. One relates to the effect of an iris in a waveguide. L. S. G.

538.566 : 621.396.677

4896. Analysis of the metal-strip delay structure for microwave lenses. COHN, S. B. *J. Appl. Phys.*, **20**, 257–62 (*March*, 1949).—The metal-strip delay medium is shown to be analogous to a transmission-line low-pass filter. A filter analysis gives the image phase constant and image admittance of the equivalent filter section. The index of refraction of the medium is obtained from the former and the reflection coefficient from the latter. It is shown that the physical parameters may be chosen so that the strip medium is perfectly matched to space at a particular frequency. Formulae are given which hold for normal incidence even when the strips are close together. The same method may be applied to delay media consisting of thin metal obstacles of any shape arranged uniformly in parallel planes. Examples are circular discs, ellipses and rectangles. Certain general conclusions are drawn for this class of media. A.

538.566.2

4897. Boundary conditions between two absorbing media in contact for the transmission of electromagnetic waves. ARZELIÈS, H. *Ann. Phys., Paris* (*Sér.* 12) **3**, 637–54 (*Nov.–Dec.*, 1948) *In French.*—This problem is dealt with inaccurately by French authors in the opinion of the writer; he attributes this to the fact that the general theory of reflection can be developed without establishing the transit relations for absorbing media explicitly. It is shown that the systematic use of these relations leads to a simple form for the general theory. A. C. M.

538.566.2

4898. Absorption of ultra-high frequency waves in salt solutions. CHATTERJEE, S. K. AND SREEKANTAN, B. V. *Indian J. Phys.*, **22**, 326–32 (*July*, 1948).—The paper describes part of an investigation [illegible] the behaviour of sea water as a medium of pr[illegible] pagation of u.h.f. waves. The percentage of absor[illegible] tion and reflection in the frequency range 300[illegible] 480 Mc/s has been measured in aqueous solutions [illegible] $MgSO_4$ and $CaCl_2$ at various concentrations. Th[illegible] experimental data are used to calculate the dielectr[illegible] constant, loss tangent and absorption conductivi[illegible] of the solutions at the different frequencies ar[illegible] concentrations. Values of molar conductivity f[illegible] $MgSO_4$ have been calculated; this quantity increas[illegible] with frequency within the range considered. A. B. [illegible]

538.566.2 : 621.396.[illegible]

4899. Propagation of electromagnetic disturbanc[illegible] in an atmospheric waveguide. KAHAN, T. AN[illegible] ECKHART, G. *C.R. Acad. Sci., Paris*, **228**, 235-[illegible] (*Jan.* 17, 1949) *In French.*—A note on the results [illegible] an analysis of the electromagnetic field produced b[illegible] an oscillatory dipole in an idealized atmospher[illegible] duct—defined by a flat, perfectly conducting grou[illegible] and an atmospheric refractive index discontinuity [illegible] amount $\sqrt{(\Delta\varepsilon)}$ at height h. For wavelength λ th[illegible] intensity of the field diminishes with distance [illegible] according to the law r^{-3} or $r^{-\frac{1}{2}}$ ("guided propagation [illegible] depending on the inequality $h\sqrt{(\Delta\varepsilon)}/\lambda < \text{or} > \frac{1}{4}$. W. J. G. B. [illegible]

538.566.3 : 621.396.[illegible]

4900. Absorption of radio waves reflected at vertic[illegible] incidence as a function of the sun's zenith angl[illegible] TAYLOR, E. W. *J. Res. Nat. Bur. Stand., Wash.*, **4[illegible]** 575–9 (*Dec.*, 1948).—An analysis of 3 years' c.[illegible] measurements on frequencies of 2·1 and 4·3 Mc[illegible] shows that to a first approximation, the daytim[illegible] ionospheric absorption at vertical incidence is [illegible] cos (solar zenith angle). W. J. G. [illegible]

538.566.5 : 621.392.[illegible]

4901. The effects of a discontinuity in the curvatu[illegible] on propagation in waveguides. JOUGUET, M. *C.[illegible] Acad. Sci., Paris*, **223**, 474–5 (*Sept.* 23, 1946) [illegible] *French.*—An $H_{p,0}$ wave is propagated in a guide [illegible] rectangular section, whose axis is curved in a pla[illegible] perpendicular to the direction of the electric fie[illegible] At a certain point the curvature suddenly chang[illegible] from one fixed value to another. Parasitic oscillatio[illegible] are set up in this neighbourhood. Expressions for t[illegible] amplitudes of these oscillations are given and sor[illegible] particular cases are discussed. L. S. G. [illegible]

538.569.4.029.6 : 621.315.61.01[illegible]

4902. High-frequency absorption in liquids a[illegible] solids. JACKSON, W. AND SAXTON, J. A. *Proc. Ins[illegible] Elect. Engrs, Pt III*, **96**, 77–80 (*March*, 1949). [illegible] The extension of the electrical frequency spectru[illegible] to beyond 10^{10} c/s has enabled a more comprehensi[illegible] study of the behaviour of dielectrics. The work [illegible] polythene, water, ice and dilute solutions of pol[illegible] materials in non-polar solvents which is describ[illegible] reveals the limitations of existing theories of dipo[illegible] absorption in liquids and solids. The possibility [illegible] observing resonance absorption effects in solids in t[illegible] microwave region is discussed. E. R. [illegible]

MAGNETIC EFFECTS 538.6

538.613 : 535.51 : 548.0

The Faraday effect and magneto-optic anomaly of some cubic crystals. *See Abstr.* 5097

538.69

4903. A thermal effect during the corrosion of metals in a magnetic field. CROATTO, U. *Ric. Sci.*, **18**, 1575–6 (*Nov.–Dec.*, 1948) *In Italian.*—When a compound is formed in a magnetic field through the direct reaction of a metal and O or S, two effects are observed, analogous to the Hall and Ettinghausen effects, the electronic flow due to the formation of the compound taking the part of the external current. L. P.

MOLECULAR AND ATOMIC STRUCTURE 539.1

THEORY OF SOLID STATE 539.11

539.11

4904. Structure and conductivity in the VI$_B$ group of the periodic system. DE BOER, F. Letter in *J. Chem. Phys.*, **16**, 1173–4 (*Dec.*, 1948).—Reference is made to a paper of the same title by von Hippel [Abstr. 3400 (1948)]. In order to explain the structure of trigonal Se and Te, and the abnormal value of the van der Waals radius, it is necessary to take into account forces of the metallic type. M. R. H.

539.11 : 548.7

4905. The vibrations of an infinite linear lattice consisting of two types of particles. NAGENDRA NATH, N. S. AND KUMAR ROY, S. *Proc. Indian Acad. Sci. A*, **28**, 289–95 (*Nov.*, 1948).—A general solution is obtained for an arbitrary displacement of one particle at $t = 0$, the forces acting being $\propto$ the displacements of the particles from their mean positions. The particular case for which the forces acting on a particle depend only on its own displacement and those of its nearest neighbours is inyestigated in detail. A. J. C. W.

539.11 : 669

4906. Structure of solids. IV. Structure of metals. DEHLINGER, U. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 77–83 (1947) *In German.*—The theoretical interpretations of the structure of metals are described. Brill *et al* determine the band structure by a Fourier synthesis based on X-ray diffraction data, and Weibke and Kubaschewski make a careful comparison of the lattice types and of heats of formation of alloys. Work on the formation of alloys, mixed crystals, solid solutions and on bonding in intermetallic compounds is carefully reviewed. C. A. H.

539.11 : 669

4907. Linear atomic chain and the metallic state. HOFFMANN, T. A. AND KÓNYA, A. Letter in *J. Chem. Phys.*, **16**, 1172–3 (*Dec.*, 1948).—The molecular orbital method in the LCAO approximation is applied to some problems concerning metals by the adaptation of treating a linear arrangement of similar atoms. Even this very simple model shows typically the development of the metallic properties; treatment is now restricted to atoms with only one valence electron arranged at equal distances from one another. It is shown, generally, that the average energy of the electrons lies lower than that of the electron in the atom, and lower, moreover, than that of the electrons in the diatomic molecule. In spite of the difference between a real metal and the present linear lattice, the latter is shown to be useful for the calculation of end-effects, e.g. dipole moments; also the effect of strange atoms built in the lattice at random or systematically (alloys) can be treated. H. H. HO.

539.11 : 669

4908. The basis of the electron theory of metals, with special reference to the transition metals. MOTT, N. F. *Proc. Phys. Soc. Lond. A*, **62**, 416–22 (*July*, 1949).—It is shown that the collective electron and London–Heitler models are not to be regarded as different approximations to the same exact wave function for solids in which, according to the former model, there is a partially filled zone of energy levels. It can thus be shown why nickel oxide in the pure state is a non-conductor, although it contains an incomplete zone. The properties of the metals Ni, Pd and Pt are discussed in the light of these results; Pt differs from Ni in that the orbital contribution to the moment of the elementary magnets is not quenched. A discussion is given of X-ray absorption edges, and it is shown why exciton lines are absent for metals. A.

MOLECULAR STRUCTURE 539.13

539.132

4909. Investigations of electron shells and the structure of molecules by other methods. STUART, H. A. AND V. LAUE, M. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of the electron shells, II*," 69–94 (1948) *In German.*—It was shown that the intensity of the light dispersed by molecules in a highly diluted solution increases proportionally with the molecular weight (degree of polymerization) if the solution contains macromolecules, and that this relationship is independent of the shape of the molecules. The only condition is that the wavelength of the light must be $>$ the dimensions of the molecules. With stretched, rigid string (chain) molecules the molecular weight increases faster than the intensity. Investigations on electrical double refraction have shown that the Kerr constant B and the optical anisotropy are the smaller, the more compact, i.e. spherical, the molecule becomes. The B-constant changes greatly with respect to the various isomers. The measurement of the electrical double refraction, together with other critical values (Raman effect, infrared absorption), will effect an exact analysis of hydrocarbon mixtures. The theory of the artificial double refraction of solution with ellipsoidal, rigid, non-conducting

particles between 10 Å and 50 000 Å, together with the measurement of the specific viscosity, allows the determination of the magnetic and electric constants, and of the size and shape, of these particles. The mobility of string (chain) molecules is such that it is $\propto$ the viscosity η_0 and to the square of the degree of polymerization P. The relaxation time Θ, i.e. the time a deformed string (chain) molecule takes for returning to an average medium length, is calculated as $\Theta = \text{const.}\ \eta_0 P^2$. W. S.

539.132

4910. On the rotational constant B_J of molecular energy levels. VALATIN, J. G. *Hungar. Acta Phys.*, **1** (*No.* 3) 1–6 (1948) *In English.*—Defining B_J by $\partial E/\partial J(J+1)$ for a diatomic molecule, it is shown to measure the mean value of $1/r^2$ for molecules of energy E even if perturbations are present, provided coupling between rotation and electronic motion is absent. D. H. W.

539.132

4911. Molecular force fields. III. The vibration frequencies of some planar XY_3 molecules. HEATH, D. F. AND LINNETT, J. W. *Trans. Faraday Soc.*, **44**, 873–8 (*Nov.*, 1948).—An "orbital valency force field" (O.V.F.F.) is introduced in which it is assumed that a central atom has bond-forming orbitals fixed at definite angles to each other, and that there is a restoring force $\propto$ the angle between the direction of one of these orbitals and the instantaneous direction of the line joining the two atoms which form the bond. With this type of bending constant (which has the same value for in- and out-of-plane bending), a bond stretching constant and a Van der Waals' term ($V = a/R^{12}$) for repulsion between non-bonded atoms, the 4 fundamental frequencies of BF_3, BCl_3, BBr_3, $CO_3^=$, NO_3^- and SO_3 are calculated to a mean accuracy of 1% for each molecule. [See also Abstr. 3367 (1949)]. D. H. W.

539.132

4912. Molecular force fields. V. The application of the orbital valency force field to some tetrahedral anions. HEATH, D. F. AND LINNETT, J. W. *Trans. Faraday Soc.*, **44**, 884–6 (*Nov.*, 1948).—Extension of Part IV [Abstr. 3367 (1949)] shows again the superiority of the O.V.F.F. over the S.V.F.F. when applied to ClO_4^-, $SO_4^=$, $SeO_4^=$ and $PO_4^{\equiv}$. D. H. W.

539.132

4913. Thermal stability of complex molecules. OBREIMOV, I. V. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 396–406 (*May*, 1949) *In Russian.*—A theory is given of the thermal disintegration of complex, in particular, organic, molecules, based on a simple assumption on the character of the thermal stability: a molecule is broken up by severance of a certain bond, if the length of this bond (chain) exceeds a certain critical value. A formula is derived for the mean and the most probable value of the inverse life-time of the molecules. The general theory thus developed is applied to the calculation of the stability of linear polyatomic molecules. B. F. K.

539.132 : 535.343 : 548.7

4914. Electronic and vibrational levels of the naphthalene crystal and molecule. PRIKHOTKO, A. F. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 383–95 (*May*, 1949) *In Russian.*—A comparison in detail was made of the absorption spectra of naphthalene vapours and crystals. In the crystal, apart from the electron series corresponding to series of the gas, there are purely crystalline electron levels, proper only to crystals. The spectral transitions to these levels from the normal state correspond to heavily polarized lines of the spectrum. The transitions to levels corresponding to the levels of the molecules in the gas correspond to weakly polarized lines of the crystal spectrum. The first category of transitions possesses crystal symmetry, the second, the symmetry of the molecule. These as well as other states interact strongly with the lattice vibrations of the crystal and produce in its spectrum a large number of characteristically distributed low-frequency lines and continuous absorption bands delimited by these lines. B. F. K.

539.132 : 541.57

4915. The molecular orbital theory of chemical valency. I. The determination of molecular orbitals. LENNARD-JONES, J. *Proc. Roy. Soc. A*, **198**, 1–13 (*July* 22, 1949).—In this theory the electrons are assigned to the whole molecule rather than to atoms or to other localized parts. While the method has advantages in dealing with the properties of a molecule as a whole, such as its energy states, the extension of each orbital over the molecular framework is a disadvantage when dealing with localized properties such as directed bonds. This paper deals in a general way with the equations which molecular orbitals must satisfy, allowing for the exchange of electrons between orbitals. It is then shown that when molecules have properties of symmetry the equations can be transformed so as to be satisfied by orbitals which have the property of equivalence. These can be regarded under certain conditions as directed orbitals and the conditions for these are discussed. To illustrate the method molecules of the type XY_2 are considered. A.

539.132 : 541.57

4916. The molecular orbital theory of chemical valency. II. Equivalent orbitals in molecules of known symmetry. LENNARD-JONES, J. *Proc. Roy. Soc. A*, **198**, 14–26 (*July* 22, 1949).—Aims at providing a connecting link between the theory of molecular orbitals and the theory of localized bonds. An examination is made of the fundamental equations which must be satisfied by molecular orbitals in fields of known symmetry, particularly in molecules of the type XY_n. It is shown by the methods of the group theory that these equations can be transformed to others which involve sets of equivalent functions. These are associated with equivalent orbitals which have the property of being identical as regards distribution in space and differ only in their orientation. It is shown that under certain conditions these can be regarded as localized orbitals associated with particular bonds. General formulae are obtained and applied to the particular cases of molecules of trigonal, tetrahedral and octahedral symmetry. A.

539.133

4917. The hydrogen fluoride dipole moment and the structure of the dimer. ORIANI, R. A. AND SMYTH, C. P. Letter in *J. Chem. Phys.*, **16**, 1167–8 (*Dec.*

1948).—The dipole moment of HF should be calculated on the basis of an equation deduced by quantum mechanics instead of by the classical expression. When this is done the value $1{\cdot}98\times10^{-18}$ is obtained for the dipole moment of HF instead of $1{\cdot}91\times10^{-18}$, the value given by the classical equation. Polarization and electron diffraction studies indicate a chain structure for the polymer. A zig-zag model leads to a reasonable value for the energy of the H bond. A. J. M.

539.133

4918. Note on the energy of a rotating molecule. Karplus, R. Letter in *J. Chem. Phys.*, **16**, 1170–1 (*Dec.*, 1948).—The magnitudes of corrections in the higher order terms in the expression of the Hamiltonian operator governing the energy of a rotating molecule are discussed. A. J. M.

539.133

4919. The vibrational constants of acetylene. Nordin, N. M. and Haslam, R. N. *Canad. J. Res. A*, **26**, 279–91 (*Sept.*, 1948).—The introduction of an interaction constant between frequencies ν_1 and ν_3 increases the consistency of the observed and calculated absorption bands. D. H. W.

539.133 : 538.083.9

4920. Nuclear magnetism in studies of molecular structure and rotation in solids: ammonium salts. Gutowsky, H. S. and Pake, G. E. Letter in *J. Chem. Phys.*, **16**, 1164–5 (*Dec.*, 1948).—The width of the proton nuclear resonance observed at 29 Mc/s in NH_4Cl decreases from 29 gauss below 133°K to 5 gauss above 133°K in a range of 16°. This transition point is below the specific heat anomaly at 243°K but hindered rotation or quantum mechanical tunnelling must be invoked to account for the narrow line above 133°K. Other NH_4 salts behave similarly and the low temp. width agrees with the theoretical predictions for an H–H distance of 1·01 Å in stationary NH_4 tetrahedra. D. H. W.

ATOMIC STRUCTURE . ISOTOPES 539.15

539.15 : 531.19

4921. The statistical theory of the atom and its applications. [*Die Statistische Theorie des Atoms und ihre Anwendungen.*] Gombás, P. *Vienna, Springer-Verlag* (1949) *pp. viii* + 406. *In German.*—About one half of this book is given to a presentation of the general theory. Properties of an electron gas of free electrons are discussed and the Fermi–Dirac statistics are explained. The interaction of free electrons is treated in detail, including the calculation, according to wave-mechanics, of the interaction energy. The statistical model of Thomas and Fermi is then studied. The potential equation is obtained and solved approximately. This is applied in a discussion of the density distribution of electron gases in the Thomas–Fermi models for atoms and ions. Corrections due to Fermi and Amaldi are noted. Extensions of the statistical model are given, based on the Thomas–Fermi–Dirac equation. Relativistic and high temp. effects are considered. Perturbation calculations are also carried out. In the second half of the book, applications are made to atoms, molecules, crystals and matter at high pressures. The use of the theory in the calculation of atomic spectra is explained, and properties of metal crystals are discussed. In an appendix, tables of solutions of the Thomas–Fermi equation and the Thomas–Fermi–Dirac equation are given and the W.K.B. method is explained. L. S. G.

539.152.1

4922. Tensor forces and the triton binding energy. Feshbach, H. and Rarita, W. *Phys. Rev.*, **75**, 1384–9 (*May* 1, 1949).—The binding energy of the triton has been calculated variationally employing the Hylleraas expansion for the trial wave functions, thus permitting a systematic improvement in the binding energy. The procedure used was tested by applying it to the binding energy problem of the deuteron with tensor forces. The present theory, assuming a rectangular-well shape with a range of $2{\cdot}8\times10^{-13}$ cm for all the internucleon potentials, yields a H^3 binding energy 40–50% of the experimental value. Various suggestions for resolving this dilemma are discussed. A.

539.152.1

4923. On the value of the electric quadrupole moment of the deuteron. Isiguro, E. Letter in *Progr. Theor. Phys.*, **3**, 312 (*July–Sept.*, 1948) *In English.*—The calculation of the gradient of the electric field in a H molecule by Nordsieck [Abstr. 3034 (1940)] has been repeated with a more refined wave-function. The quadrupole moment is then $2{\cdot}79\times10^{-27}$ cm^2 as compared with Nordsieck's value of $2{\cdot}73\times10^{-27}$. G. J. K.

539.152.1

4924. Law of four. IV. Helionic structure of the nucleus of elements. Neutrons in excess of this and their respective importance. Oddo, G. *Gazz. Chim. Ital.*, **76**, 404–9 (1946).—On the basis of the theory that nuclei of elements contain He atoms, the elements are tabulated, with their number (h) of He atoms, of complementary deuterons (d) (0 or 1) (so that $2h + d = Z$), of total neutrons ($A - Z$), of neutrons paired with protons in the atoms (Z), and of excess of neutrons ($n = A - 2Z$). In the atomic table, n increases, irregularly, at a greater rate than h, until n is $> h$. This is discussed in relation to spontaneous and chain atomic fission. B. A.

539.152.1

4925. The first-order approximation to the energy density of a nuclear liquid. Nan, K. S. *C.R. Acad. Sci., Paris*, **227**, 1157–9 (*Nov.* 29, 1948) *In French.*—A closed expression is obtained for the energy of N neutrons and Z protons in a volume with a central meson interaction of all 4 exchange types. It is a perturbation calculation, using plane-wave single particle wave-functions as the unperturbed functions. G. J. K.

539.152.1

4926. On closed shells in nuclei. Ellis, C. B. Letter in *Phys. Rev.*, **74**, 1547 (*Nov.* 15, 1948).—A chart of isotopes plotting N *v.* Z for stable isotopes shows clearly the regions of particular stability and

instability, and the 2 main slopes of the stability curve. G. J. K.

539.152.1

4927. Nuclear relaxation in ice at −180°C. PAKE, G. E. AND GUTOWSKY, H. S. Letter in *Phys. Rev.*, **74**, 979–80 (*Oct.* 15, 1948).—The spin relaxation time for protons in ice at −180°c is found to be $T = 10 \pm 1$ min. This is 10^{-5} < would be expected by correlation with the dielectric relaxation time estimated at this temp., assuming that the orientation process is the same in both cases. G. J. K.

539.152.1 : 530.14

Relativistic terms in the interaction between nucleons in pseudoscalar and vector meson theory. *See Abstr.* 4459

539.152.1 : 530.145.6

Symmetrical meson theory of nuclear forces. *See Abstr.* 4481

539.152.1 : 530.162

Heisenberg principle of indeterminacy. *See Abstr.* 4490

539.152.2 : 537.133

Magnetic moment of the proton. *See Abstr.* 4750

539.153

4928. On the g_J values of the alkali atoms. The hyperfine structure of the alkali atoms. KUSCH, P. AND TAUB, H. *Phys. Rev.*, **75**, 1477–80 (*May* 15, 1949).—Measurements have been made on the ratios of the g_J values of the alkali atoms. It is found that the g_J values of Li^6, Li^7, Na and K^{39} are identical to within one part in 40 000. The g_J of Rb and Cs, however, are > the g_J of the other alkalis by 5 and 13 parts in 100 000 respectively. Effects which modify the g_J value of an atom may be expected to depend on the detailed electronic configuration of an atom. Since the g_J values of Li, Na and K are shown, in present experiments, to be equal, it can be presumed, in view of the different electronic structures of these atoms, that perturbing effects are negligible and that the g_J values of these atoms are, in fact, equal to the electron spin gyromagnetic ratio. A.

539.153 : 530.145.6

4929. On the angular momentum of the atomic nucleus induced by its surface vibrations. NOGAMI, M. *Progr. Theor. Phys.*, **3**, 362–8 (*Oct.–Dec.*, 1948) *In English.*—The angular momentum of a liquid drop in the steady states of its quantized surface vibrations is shown to be closely related to the vibrational quantum numbers, which, as numbers of nodes, appear in Flugges' theory of nuclear isomerism. G. J. K.

539.153 : 535.33

Investigation of electron shells by spectroscopic methods. *See Abstr.* 4627

539.154.2

4930. Free volumes of the metallic elements at their melting points. PENNER, S. S. Letter in *J. Chem. Phys.*, **16**, 745–6 (*July*, 1948).—Free volumes, v_f, of metallic elements at their m.p. have been calculated from the equation $v_f = (RT/2\pi Mv^2)^{3/2}$ where M is the at. wt. and v is the characteristic vibration frequency. Values of v_f generally lie between 10 and 50×10^{-27} cm². The ratio of v_f to v (total volume at m.p.) is approximately 10^{-3} and some regularity in the dependence of this ratio on atomic number is indicated. W. R.

539.154.3 : 530.14

Charge density and magnetic moment of nucleon *See Abstr.* 4470

539.154.3 : 548

4931. Atomic magnetic moments of metals of the iron group and inter-atomic distances. GALPERIN, F. M. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 451–[illegible] (*May*, 1949) *In Russian.*—The relation is studied between the atomic magnetic moments of the hard face-centred cubic metals of the Fe group and their inter-atomic distances. Numerical relations are given, suitable for calculations. The investigation was based on the zonal theory of metals which satisfactorily explains the connection between the same characteristics. The same relations could also be found to exist in alloys and chemical compounds of these metals and, in a particularly striking way, in tellurides of Cr. B. F. I.

539.155

4932. Natural variations in the isotopic content of sulphur and their significance. THODE, H. G., MACNAMARA, J. AND COLLINS, C. B. *Canad. J. Res. B*, **27**, 361–73 (*April*, 1949).—Mass spectrometer abundance measurements for samples obtained from a wide variety of sources show considerable variations. The isotopic ratios S^{32}/S^{33} and S^{32}/S^{34} were found to vary by as much as 2·5 and 5% respectively. This would mean a corresponding variation of 10% in the S^{32}/S^{36} ratio. Variations in the S^{32}/S^{34} ratio were determined with a precision of ±0·05%. In general sulphates whether present as gypsum deposits or in solution were found to be enriched in the heavier isotopes of S. On the other hand, the H_2S of sulphuretted well waters was usually low in these isotopes even though present in the same solutions with the sulphates. These variations are in the direction expected from theoretical considerations. A correlation between crystallization temp. of pyrite and isotopic content has been found for crystals removed from the same specimen. However, no correlation was found between crystallization temp. or geological age and isotopic content for pyrite samples collected from different geographical locations. The results indicate that the changes in the isotopic content of S that occur are related to the differences in chemical properties of isotopic compounds. A.

539.155.

4933. The masses of the heavy isotopes. STERN, M. O. *Rev. Mod. Phys.*, **21**, 316–21 (*April*, 1949).—Radioactive decay data are used to calculate the atomic masses of the heavy isotopes, $A \geqslant 202$. The data have been critically surveyed; in some cases these have been supplemented by construction of tentative energy level schemes or by estimates of decay energies. With the adoption of certain assumptions a connection between the different radioactive families is made possible. The masses thus obtained have been tabulated and plotted. Atomic weight 209 on the Weizsäcker–Fermi formula is found to be unsatisfactory for the calculation of the masses, results deviating by as much as 0·020 mass units from those

obtained by experimental data if the latter be adjusted to the calculated ones in the region of Pb. A.

539.155.2

4934. He^3 isotopic abundance. COON, J. H. *Phys. Rev.*, **75**, 1355–7 (*May* 1, 1949).—The isotopic abundance of He^3 in one sample each of "well" He and "atmospheric" He has been measured by detecting the $He^3(n,p)H^3$ disintegrations induced by thermal neutrons. The He gas was put into a proportional counter, the disintegration rate compared to that with N in the counter, and the He^3 content deduced from the known ratio of the He^3 and N disintegration cross-sections. A.

539.155.2

4935. Radioactive isotopes of the rare earths. I. Experimental techniques and thulium isotopes. WILKINSON, G. AND HICKS, H. G. *Phys. Rev.*, **75**, 1370–8 (*May* 1, 1949).—The experimental techniques used in chemical separation and identification of radioactive isotopes of the rare-earth elements are described. The isotopes are produced by bombardment of rare-earth oxides with α-particles, deuterons and protons from the 60 in Crocker Laboratory cyclotron, and also by bombardment of Ta with 200 MeV deuterons from the 184 in cyclotron. The production and properties of 3 new Tm isotopes are described. A.

539.155.2

4936. On the separation of artificially radioactive $_{79}Au^{198}$ in unweighable amounts from the stable isotope. HERR, W. *Z. Naturforsch.*, **3a**, 645–7 (*Dec.*, 1948) *In German.*—The complex

$$[C_6H_5 . CO . C : C(OH) . (C_6H_5)_3Si]AuCl_4$$

was found to be very suitable for use in a Szilard–Chalmers separation. In particular it resists decomposition by moisture. Details are given of the preparation of the complex. 3 methods of separation of the active Au are described; the most efficient extracts ~95% of the available activity A. P. F.

539.155.2

4937. On further regularities in the system of isotopes. LEVITSKAYA, M. A. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 1) 45–6 (1948) *In Russian.*—A table of isotopes of "maximum content" published previously [Levitskaya, M. A., *Ibid.*, **55**, 309 (1947). See also Abstr. 2611 (1947)] is considered and a further regularity in the arrangement of isotopes is pointed out. If the part separated by a dotted line in the table is excluded (the so-called special zones) the numbers in the 6th column up to $Z = 32$ are almost without exception $= +1$ while for $Z > 32$ they are almost without exception $= -1$. In the special zones there is greater variation and the regularity in signs observed is destroyed (at $Z = 2{\cdot}74$ and 80). A theory is developed to explain this regularity but since it is too hypothetical it is not considered in detail. W. H.

539.155.2 : 539.162

4938. On the existence of a new isotope of radon, Rn^{218}. WALEN, R. *C.R. Acad. Sci., Paris*, **227**, 1090–2 (*Nov.* 22, 1948) *In French.*—Experiments with Ra active deposit show a further α/β branching at $_{85}At^{218}$ (ratio $\sim 1:10^{-3}$) in addition to that at $_{84}RaA^{218}$ found by Karlik and Bernert [see Abstr. 3629 (1947)]: the β-disintegration product of $_{85}At^{218}$ is $_{86}Rn^{218}$ which decays by α-emission to $_{84}RaC'^{214}$. A. O. S.

539.156

4939. Atomic interaction in penetration phenomena. BOHR, A. *K. Danske Vidensk. Selsk. Mat.-fys. Medd.*, **25** (*No.* 19) 1–52 (1948) *In English.*—An original review in terms of simple physical concepts. The matter penetrated is usually described in a macroscopic way as a continuum (Fermi, Swann, Tamm), but in order to bring out the connection with the simple collision theory a microscopic point of view is adopted. A distinction between close and distant collisions is made—the mutual interaction between atoms being only important for the latter—which leads to a simple classical mechanical theory of stopping power and the influence of atomic binding forces. Atomic interaction is regarded as a further screening closely analogous to binding forces, while the energy loss is treated as due to a force with which the atoms of the medium act on the moving particles. For relativistic particles atomic interaction presents new aspects. Čerenkov radiation and its relation to the stopping power is discussed. It is that part of the energy transferred to the electrons of the medium which is subsequently reradiated as coherent electromagnetic waves. A distinction made between the energy loss of particles which is absorbed by the substance in the vicinity of the path and loss transmitted over larger distances in the form of radiation leads to general relations regarding the stopping power for relativistic and non-relativistic particles. Comprehensive expressions for the stopping power of heavy substances are deduced. Experimental data are discussed and satisfactory agreement with theory of stopping power of metals and the stopping and ionization of very fast particles is found. H. M.

539.156

4940. The calculation of interaction potentials from collision cross-section measurements. KELLS, M. C. Letter in *J. Chem. Phys.*, **16**, 1174–5 (*Dec.*, 1948).—A consistent approx. treatment for the determination of K in the expression $V(r) = -K/r^n$, where r is the distance of separation of the centres of mass of the interacting particles is given. The calculation of a correct value of K is therefore rendered unnecessary. A. J. M.

RADIOACTIVITY . α-, β- AND γ-RAYS 539.16

539.16.08 : 537.542

The measurement of radioactive isotopes. *See Abstr.* 4835

539.163

4941. Neutron deficient isotopes of cerium and lanthanum. CHUBBUCK, J. B. AND PERLMAN, I. Letter in *Phys. Rev.*, **74**, 982–3 (*Oct.* 15, 1948).—The radiations from La^{135}, La^{136}, Ce^{135}, Ce^{137} and Ce^{139}, produced by the bombardment of Cs and La with high energy He and D beams from the Berkeley cyclotrons, were studied with a β-spectrometer and by absorption methods. It is suggested that the previously reported activities of La^{137} and La^{138} [see

Abstr. 1713 (1943), 4243 (1937)] should be assigned to La^{135} and La^{136} respectively. B. R.

539.163

4942. Columbium 96. KUNDU, D. N. AND POOL, M. L. *Phys. Rev.*, **75**, 1690–2 (*June* 1, 1949).—Cb^{96} has a ½-life of 23·35 hr. It decays with the emission of negative β-particles of max. energy 0·67 MeV and 1·03 MeV γ-rays. No X-rays are emitted. The assignment is made by using enriched isotopes of Zr. A.

539.163

4943. Radioactive isotopes of the rare earth elements. II. Neodymium isotopes. WILKINSON, G. AND HICKS, H. G. *Phys. Rev.*, **75**, 1687–90 (*June* 1, 1949).—The techniques of study of radioactive isotopes of the rare earth elements described previously have been applied to Nd. Using a 60 in cyclotron, bombardments have been made of Pr with 19 and 9 MeV deuterons and 10 MeV protons. Half-lifes and radiations of the resulting nuclei are given. A.

539.163

4944. Radioactive scandium and vanadium. KRISBERG, N. L. AND POOL, M. L. *Phys. Rev.*, **75**, 1693–5 (*June* 1, 1949).—An activity with a ½-life of $33·0 \pm 0·5$ min was produced by the reaction $Ti^{47}(p,n)$ with approx. 10 times the intensity which was produced by the reaction $Ti^{46}(p,\gamma)$ and is assigned to V^{47}. It was found that V^{47} decays by the emission of a γ-ray and a positive β-particle of 1·65 MeV. Assignment of the $3·43 \pm 0·03$-day ½-life to Sc^{47} was definitely confirmed by comparing the reactions $Ti^{49}(d,\alpha)$ and $Ti^{50}(d,\alpha)$. Sc^{47} decays to stable Ti^{47} by the emission of a γ-ray and a negative β-particle of 0·61 MeV. The $Ti^{50}(d,\alpha)$ reaction was found to give the 1·83-day ½-life of Sc^{48}. A.

539.163.1

4945. Half-life of UX_1 (Th^{234}) KNIGHT, G. B. AND MACKLIN, R. L. Letter in *Phys. Rev.*, **74**, 1540–1 (*Nov.* 15, 1948).—A redetermination of the ½-life of UX_1, (Th^{234}) has been made using a sample of UX_1, as pure as possible, and taking particular care over the counting technique. The results are statistically analysed and yield a figure of $24·101 \pm 0·025$ d, which is in good agreement with Sargent's earlier result. [See Abstr. 3608 (1939)]. G. O. B.

539.163.1

4946. Long-lived metastable state of Te^{125}. FRIEDLANDER, G., GOLDHABER, M. AND SCHARF-GOLDHABER, G. Letter in *Phys. Rev.*, **74**, 981–2 (*Oct.* 15, 1948).—Te^{125} separated chemically from Sb^{125} was found by absorption methods to emit electrons of max. energy ~ 120 keV, and soft X-rays. If present, γ-rays of energy ~ 120 keV must have intensity $< 1\%$ of the conversion electrons. A weak Te source separated from I^{125} had an electron absorption curve with the same shape and end-point. B. R.

539.163.1

4947. Characteristics of the fission product Cs^{135}. SUGARMAN, N. *Phys. Rev.*, **75**, 1473–6 (*May* 15, 1949).—Two samples of Xe^{135} of high intensity were prepared at the Los Alamos homogeneous pile. The decay products of the gas contained a Cs activity presumed to be Cs^{135}. The ½-life of Cs^{135} was found to be $(2·1 \pm 0·7) \times 10^6$ yr and the maximum ene of its β^--radiations 0·21 MeV. No γ-radiatio were detected. The capture cross-section of C for pile neutrons was determined to be $14·5 \pm$ barns.

539.163.1 : 539.16

4948. On the radioactivity of K^{40}. HIRZEL, O. A WÄFFLER, H. Letter in *Phys. Rev.*, **74**, 1553 (*Nov.* 1948).—Continuing earlier work, the authors affirm their value of 1·41 MeV for the upper limit t the β-ray spectrum of K^{40}. They also determi that $8·7 \pm 1·2$ γ-quanta are emitted per 100 β-ra and that the ½-life of the transition $K^{40} \rightarrow Ca^{40}$ $(11·1 \pm 1·9) \times 10^8$ years. G. O.

539.16

4949. The radioactive decay of K^{40}. BORST, L. AND FLOYD, J. J. Letter in *Phys. Rev.*, **74**, 989– (*Oct.* 15, 1948).—The number of β-counts fro a sample of KCl enriched 14-fold in K^{40} gave partial disintegration const. for β-emission, λ_β $(3·9 \pm 0·4) \times 10^{-10}$ yr^{-1}. The Al absorption cur compared by the Feather method with RaE, gave extrapolated range of 900 mg/cm² ($E_{max} = 1·9$ 0·2 MeV): the 2 curves are identical in shape, b K^{40} gives many more low energy electrons than UX It is more likely that the γ-ray of 1·55 MeV (λ_γ $(0·62 \pm 0·02) \times 10^{-10}$ yr^{-1}) is associated with very soft (undetected) β-ray (in which case λ_γ mu be added to λ_β) than with the electron capture (wh λ_γ is included in λ_e). The yield of permanent gas from a sample of Permian sylvite (KCl) of estimat age $\sim 2 \times 10^8$ yr, gave a partial disintegration con for electron capture $\lambda_e \simeq 2·8 \times 10^{-10}$ yr^{-1}, assumi all the gas to be A, and no loss of A from the miner The total decay const. $(\lambda_\beta + \lambda_\gamma + \lambda_e)$ is th $(5·9 - 16·5) \times 10^{-10}$ yr^{-1}, or the ½-life $(4 - 12)$ 10^8 yr. Assuming a ½-life of 6×10^8 yr, the estimat heat output of natural K at petrogenesis ($\sim 2·4$ 10^9 yr ago) is 300 μcal/yr per gm K, ~16 times t current value. A. O.

539.163

4950. Discrepancies caused by source charging beta-spectrometers. BRADEN, C. H., OWEN, G. E TOWNSEND, J., COOK, C. S. AND SHULL, F. B. Lett in *Phys. Rev.*, **74**, 1539–40 (*Nov.* 15, 1948).—Certa discrepancies in the particle spectrum of Na (½-life ~ 3 yr, emits β^+,γ) were traced to the chargi up of the source, mounted on an insulating (Zapo film, with respect to the β-spectrometer. T potential difference increased exponentially ~ 20 keV, and would presumably affect the shap of the spectrum at low energies, as well as shiftin it along the energy axis. No effect was found wi an earthed Al foil as backing. With Na^{22}, electro of $\leqslant 1$ keV were found, with intensity $\sim 0·5$ that the positrons: their source is not yet known. A. O.

539.163

4951. On the disintegration of Br^{80} isomer CHATTERJEE, S. D. AND SAHA, N. K. *Indian J. Phys* **22**, 515–30 (*Dec.*, 1948).—Br^{80} isomers were produce by irradiation of Br with slow or fast neutrons fro a Ra–Be source, and the β-endpoints determined b absorption methods to be 2·02 MeV for both isome for slow neutrons, but 2·02 and 2·26 MeV for th

4·4 hr and 18 min isomers respectively for fast neutron irradiation. The ratios of the 18 min to the 4·4 hr activity were found to be 2·1 and 2·7 for slow and fast neutrons respectively. A level scheme is suggested. B. R.

539.163.2

4952. Disintegration of Ni^{65}. Siegbahn, K. and Ghosh, A. *Ark. Mat. Astr. Fys. A*, **36** (*No.* 19) 1–11 (1948) *In English.*—The β-spectrum of the 2·6 hr activity, produced by D bombardment of Ni, was investigated in a magnetic lens spectrometer. A complex spectrum was found with end points, 2·10 MeV, 1·01 MeV and 0·60 MeV. Photoelectrons and Compton electrons from a Pb radiator revealed γ-ray energies, 1·49 MeV, 1·12 MeV and 0·37 MeV. The relative γ-ray intensities were obtained from the Compton spectrum and β–γ and γ–γ coincidence measurements. A decay scheme is proposed in which 29% of the β emissions go to an excited state of 1·49 MeV, 14% to an excited state of 1·12 MeV and 57% go direct to the ground state of Cu^{65} with a total energy of 2·10 MeV. L. R. S.

539.163.2

4953. Radiations from Ge^{77} and Ge^{71}. Mandeville, C. E., Woo, Y. H., Scherb, M. V., Keighton, W. B. and Shapiro, E. *Phys. Rev.*, **75**, 1528–31 (*May* 15, 1949).—The 12-hour Ge^{77} was found to emit β-rays of energy 1·74 MeV and γ-rays of 0·5 MeV. β–γ-coincidences were measured in the 12-hour period. The 40-hour positron emitter is not formed by slow neutrons on Ge. The 11-day Ge^{71} decays with the emission of the X-rays of Ga following orbital electron capture. Previously obtained absorption curves have given evidence of emission of charged particles by the 11-day period. This misinterpretation is discussed. A.

539.163.2 : 539.165

4954. On the electrons emitted by ionium. Teillac, J. *C.R. Acad. Sci., Paris*, **227**, 1227–9 (*Dec.* 8, 1948) *In French.*—Cloud-chamber observations show that the low-energy electrons (~10 per 100 α-disintegrations) emitted by Io are consistent with the internal conversion ($\alpha \sim 0{\cdot}9$) of the 68 keV γ-ray in the *L*, *M*, *N* shells of Ra. The ~ 190 keV γ-ray emits $\gtrsim$ 1 electron per 100 α-disintegrations. A. O. S.

539.163.2 : 539.166

4955. On the gamma radiation of ionium. Curie, I. *C.R. Acad. Sci., Paris*, **227**, 1225–7 (*Dec.* 8, 1948) *In French.*—Io emits γ-rays of 68 and 150–200 keV, and strong Ra *L*-X-rays, with rel. intensities 0·7, 0·2 and 10 per 100 α-disintegrations, considerably > those of Ward [see Abstr. 2038 (1939)]. The 68 keV γ-ray is highly converted ($\alpha \sim 0{\cdot}9$) [Abstr. 4954 (1949)], but the total intensity is still too small to account for the number of low-energy α-particles observed [Abstr. 4960 (1949)]. A. O. S.

539.163.2 : 539.166

4956. Anomalous absorption of RaC gamma-rays. Sen Chaudhary, P. K. *Indian J. Phys.*, **22**, 342–6 (*Aug.*, 1948).—RaC γ-rays show an absorption coeff. of ~ 0·30 cm^{-1} between 22 and 25 cm Pb absorber, compared with the theoretical min. of 0·47 cm^{-1}: it increases again between 25 and 27 cm absorber. Two possible causes, (1) a neutral electro-meson radiation, (2) multiple scattering in the forward direction, are discussed [but the probable cause is statistical fluctuation, since the standard errors given are too low]. A. O. S.

539.163.2 : 534.172

4957. Gamma-rays from the reaction $H^1(n,\gamma)D^2$ and the binding energy of the deuteron. Bell, R. E. and Elliott, L. G. Letter in *Phys. Rev.*, **74**, 1552–3 (*Nov.* 15, 1948).—The momentum distributions of the photoelectrons and Compton recoil electrons ejected from a U target by the γ-rays provided by the $H^1(n,\gamma)D^2$ reaction, has been used to determine the energy of the γ-rays. The binding energy of the deuteron is thus deduced to be 2·237 ± 0·005 MeV, which differs appreciably from previous values. From this value the authors deduce a figure of 1·008992 ± 0·000010 a.m.u. for the mass of the neutron. G. O. B.

539.164

4958. Determination of the range of α-particles by the decomposition of potassium iodide. Jech, Č. *Coll. Czech. Chem. Comm.*, **12**, 381–3 (1947).—The range of α-particles may be determined by observing the thickness of the coloured layer produced when an α-particle source is placed in contact with a starch gel containing I. Values for α-rays from Ra–Em, Ra*C′* and Ra*A* + Ra*C′* are in fair agreement with published values of the range in H_2O of α-particles from these sources. B. A.

539.164

4959. On the relationship between decay-energy and nuclear structure of α-radiators. Karlik, B. *Acta Phys. Austriaca*, **2** (*No.* 2) 182–6 (1948) *In German.*—The relationship between the energy of α-particles and the mass numbers from 210–244 of decaying isotopes is shown diagrammatically. The α-energies of recently discovered α-emitters from $Z = 83$–92 fall well within the values expected from the graph, so that interpolations and predictions of hitherto unknown α decay can be made. It is believed that the α decay leading to emanation of Np, Em^{221} has so far escaped observation. Attention is drawn to the fact that only AcX falls off the curve and that this nucleus is also in disagreement with the Geiger–Nutall relation. R. H. H.

539.164

4960. The fine structure of the magnetic spectrum of ionium alpha-particles. Rosenblum, S., Valadares, M. and Vial, J. *C.R. Acad. Sci., Paris*, **227**, 1088–90 (*Nov.* 22, 1948) *In French.*—Preliminary report on the α-particle spectrum of Io, obtained with a large permanent-magnet spectrograph by counting the individual photographic α-particle tracks after exposures of 4–21 d. The main group is at 4·682 ± 0·010 MeV (ThC = 6·086 MeV) with a subsidiary group (intensity ~ $\frac{1}{5}$) 69 keV less, and possibly a small group 173 keV less; the 2 main groups may be complex. α-particles from the Ra produced during ~ 3 yr could be counted; $\frac{1}{2}$-lives of ~ 10^8–10^9 yr might be measured similarly. A. O. S.

539.164

4961. Measurement of the energies of α-particles. Cranshaw, T. E. and Harvey, J. A. *Canad. J. Res. A*, **26**, 243–54 (*July*, 1948).—Using an A-filled

parallel plate ionization chamber, with α-particle sources mounted on the h.v. electrode, and with a grid to shield the collecting plate from induction effects, electron pulses ∝ α-particle energy were obtained. After amplification and shaping of the pulses, a known voltage was subtracted from them, the small difference pulses then being further amplified and recorded in a pulse-size analyser. The experimental width at ½ height of a group of pulses from a mono-energetic source was as low as ~ 50 keV equivalent. The following α-particle energies (MeV) are given: U^{233}, 4·823; Ac^{225}, 5·801; Fr^{221}, 6·298; At^{217}, 7·023; Po^{213}, 8·336; Pu^{239}, 5·159. (Errors ~ ± 5–10 keV). A. P. F.

539.164 : 539.172.4

4962. Alpha-particles from fission as recorded by photographic emulsions. Marshall, L. *Phys. Rev.*, **75**, 1339–44 (*May* 1, 1949).—80 long-range α-particles coincident with U^{235} fission have been observed in photographic plates. There is a tendency for the α-particles to emerge with greatest energy at an angle slightly > 90° from the heavy fragment. In accordance with previous observers, it is found that most α-particles emerge approximately perpendicular. It is also found that the majority form an angle slightly obtuse to the heavy fragment. The energy of the α-particles is found to be derived largely from the kinetic energy of the fission fragments. The α-emitting fissions have approx. the same mass-ratio as do normal fissions. A.

539.164.2

4963. Application of Gamow's theory of α-emission to $(4n + 1)$ radioactive series. Biswas, S. and Patro, A. P. *Indian J. Phys.*, **22**, 539–46 (*Dec.*, 1948) *In English.*—Calculated values of nuclear radii for the Np $(4n + 1)$ series are compared with the 3 natural radioactive series extended into the transuranic region. There are considerable, still unexplained, irregularities. A. O. S.

539.165

4964. On the theory of β-disintegration. Tanikawa, Y. *Progr. Theor. Phys.*, **3**, 338–48 (*Oct.–Dec.*, 1948) *In English.*—A β-decay theory is constructed assuming that $N \rightarrow e + M^- \; \rho \rightarrow \gamma + M^+$, where M is a very heavy meson. The selection rules are of the Fermi type, but for an allowed transition both proton and neutron are in an S-state and the spin change $\Delta S = 0, \pm 1$. The interaction constant for the above processes is very small, and the heavy meson has a lifetime varying as the inverse square of the difference between its mass and that of the nucleons. G. J. K.

539.165 : 537.542

A methane flow β-proportional counter. *See Abstr.* 4836

539.165.2

4965. On *e*-creation. Jean, M. *C.R. Acad. Sci., Paris*, **226**, 2064–6 (*June* 21, 1948) *In French.*—Further results are given on the probabilities of the electron creation process, for various nuclear charges Z, allowing for creation in other states than the K-shell. For Li, with $W/mc^2 = 1·0$ the ratio of this prob. to that of β-emission is $1·9 \times 10^{-3}$, and it decreases rapidly with increasing W and slowly with increasing Z. For *e*-creation alone a lower limit [illegible] the mean lifetime is ~ 10^{10} years, for all Z, corresponding to $W = mc^2$. These values are obtain[ed] using an effective nuclear charge and Hartree wa[ve] functions, with a relativistic correction. For stripp[ed] nuclei the mean lifetimes vary from 10 years f[or] $Z = 1$ to 2·6 days for $Z = 90$ [see Abstr. 732 (1948)] G. J.

539.165

4966. Radioactive nuclei of the type $_zM^{2z-1}$. Dzhelepov, B. S. *J. Exp. Theor. Phys., USSR*, (*No.* 5) 361–82 (*May*, 1949) *In Russian.*—It is shown that all features of the radioactive disintegration $_zM^{2z-1}$ nuclei may be predicted from simple, semi-empirical conceptions, more particularly: that [the] nuclei of this type, beginning with $_6C^{11}$, disintegrate with positron emission; the β-disintegration of the nuclei is determined by the transition to the basic level of the product-nucleus; the β-transition to the lowest level is not accompanied by γ-radiation; the β-spectrum of the basic transition must satisfy Fermi's formula. The disintegration constant of the β-disintegration was determined as a function of the wavelength (with a probable deviation of 3%); the ratio of the probabilities of K-capture and positron emission was also determined. The half-life of the $_zM^{2z-1}$ nuclei may be represented by $\tau = 1·32 \cdot 10^3(Z - 4)^{-10/3}$ sec (probable deviation 15%). The radii of the nuclei $_zM^{2z-1}$ vary smoothly with A according to a formula given, the deviation of which for $Z = 6$–21 does not exceed 8% (average 3%). The masses of the nuclei $_zM^{2z-1}$ may be determined from the masses of the product nuclei $_{z-1}M^{2z-1}$. B. F.

539.16

4967. Angular correlation of successive gamma-ray quanta. II. Brady, E. L. and Deutsch, M. Letter in *Phys. Rev.*, **74**, 1541–2 (*Nov.* 15, 1948).—The authors have repeated some earlier work on this subject [Abstr. 727 (1948)] using scintillation counters to increase the accuracy. Of the 6 substances examined, Co^{60}, Na^{24}, Sc^{46}, Cs^{134}, Rh^{106} and Y^{88}, only the latter does not show the most probable angle, between the directions of emission of the quanta, to be π. In all cases an anisotropic correlation was found. The significance of the results is discussed. G. O. E.

539.16

4968. Correlation between direction and polarization of successive gamma-ray quanta. Deutsch, M. and Metzger, F. Letter in *Phys. Rev.*, **74**, 1542–3 (*Nov.* 15, 1948).—A γ-ray polarimeter using naphthalene scintillation counters is described; for plane-polarized radiation the extrapolated ratio, D, of counting rates in positions parallel with and perpendicular to the plane of polarization is 2·1 ± 0·3. The correlation between the direction of emission and the polarization of the 2 successive γ-ray quanta emitted by the excited states of Pd^{106} (source of Rh^{106}) is investigated. Fair agreement with theory [Abstr. 1150 (1949)] is obtained, considerably improved with a value for $D = 1·76$. The parities of the second excited and the ground states of Pd^{106} are the same if the 2 transitions are quadrupole they are electric. A. O. S.

539.166

4969. Internal conversion coefficients for magnetic multipole radiation. SCHAFROTH, R. *Helv. Phys. Acta*, **21** (*No.* 6) 499–504 (1948) *In German.*—These coefficients, which vanish in a non-relativistic approximation, are evaluated by treating relativistic corrections as a perturbation. The formulae obtained are complicated. L. P.

539.166

4970. Precision measurements of gamma-rays from I^{131} with the 2-meter focusing curved crystal spectrometer. LIND, D. A., BROWN, J., KLEIN, D., MULLER, D. AND DUMOND, J. *Phys. Rev.*, **75**, 1544–5 (*May* 15, 1949).—With the 2 m curved crystal focusing spectrometer, 3 nuclear γ-ray lines from I^{131} have been found to have wavelengths $(34{\cdot}033 \pm 0{\cdot}01)\times10^{-11}$ cm, $(154{\cdot}671 \pm 0{\cdot}01)\times10^{-11}$ cm, $(43{\cdot}622 \pm 0{\cdot}02)\times10^{-11}$ cm, which when converted to energies give $364{\cdot}18 \pm 0{\cdot}1$, $80{\cdot}133 \pm 0{\cdot}005$, $284{\cdot}13 \pm 0{\cdot}1$ expressed in keV. The sum of the last two energies equals the first to an accuracy of 1 part in 4 500, thus verifying a decay scheme proposed by Metzger and Deutsch in which the 80 and 284 keV lines form a cascade between the same pair of excited levels of Xe^{131} as the initial and final levels for the 364 keV line. An alternative proposal seems also thus to be invalidated. The intensities of the lines are discussed, and a method of calibrating the efficiency of the multicellular Geiger counter as a function of wavelength depending on the use of such cascades is proposed. This is probably the first time that a precision test of the Ritz combination principle as applied to nuclear γ-rays has been possible. It also furnishes an excellent internal check of the reliability of the wavelength scale of the 2 m curved crystal spectrometer. A.

539.166

4971. Three-photon annihilation of an electron-positron pair. ORE, A. AND POWELL, J. L. *Phys. Rev.*, **75**, 1696–9 (*June* 1, 1949).—Annihilation of an electron-positron pair accompanied by the emission of 3 photons is discussed for the case of small relative velocity of the 2 particles. The energy spectrum of the photons is derived and the cross-section for the process is calculated. The ratio of this cross-section to that of ordinary 2-photon annihilation is found to be 1 : 370. When the result is applied to the ^3S ground state of the positronium atom, for which 2-photon annihilation is forbidden, a lifetime of $1{\cdot}4\times10^{-7}$ sec is obtained. A.

539.166.2

4972. γ-radiation from Be^8. DEVONS, S. AND HINE, M. G. N. Letter in *Phys. Rev.*, **74**, 976–8 (*Oct.* 15, 1948).—Angular distributions of the γ-radiation produced from a thin target in the reaction $Li^7(p,\gamma)Be^8$ for proton energies of 300 to 800 keV were found to be of the form $1 + \alpha\cos\theta$. A curve is given showing the variation of α with energy, giving maximum values of $|\alpha| \simeq 0{\cdot}3$ at 350 and 620 keV. For a thick target and $E_p = 500$ keV, $\alpha = 0{\cdot}05$. Measurements indicate that the asymmetry is mainly due to the 17 MeV line. The theoretical implications of the results are discussed. B. R.

539.166.835 : 539.165.8

4973. Pair production by photons and Bremsstrahlung in the field of the electron. NEMIROVSKI, P. E. *J. Exp. Theor. Phys., USSR*, **18**, 893–902 (*Oct.*, 1948) *In Russian.*—A calculation of the effective cross-section for pair formation by a photon in the field of the electron, account being taken of exchange effects, time lag and spin interaction. The special case of small energies of all particles after collision, and the extreme relativistic case are considered in greater detail. The Bremsstrahlung given out in a collision between two electrons is estimated. A.

539.166.9

4974. Theory of internal conversion. MEYER, H. A. Letter in *Phys. Rev.*, **74**, 979 (*Oct.* 15, 1948).—The quantum electrodynamics due to Schonberg using advanced and retarded fields is used to calculate internal conversion in the K-shell for $Z = 84$. The results differ from those of Hulme by approx. the same amount at all energies. For the highest energy this difference is, however, some 30%. G. J. K.

539.167

4975. The energy spectrum of the delayed neutrons from O^{17}. HAYWARD, E. *Phys. Rev.*, **75**, 917–19 (*March* 15, 1949).—Following the β-decay of N^{17} an excited state of O^{17} is formed that is unstable against neutron emission. The energy distribution of these neutrons has been measured with a H-filled cloud chamber. The results indicate that the β-decay of N^{17} leaves the O^{17} nucleus in one or more excited states and that, if there is only one excited state, it is at least 0·6 MeV wide. A.

NUCLEAR REACTIONS 539.17

539.17

4976. The effects of nuclear stability on the formation of the chemical elements. SMART, J. S. *Phys. Rev.*, **75**, 1379–84 (*May* 1, 1949).—Nuclear stability considerations are applied to the neutron capture theory of the formation of the chemical elements. It is shown that the matter density during the time of formation must have remained within the limits 10^{-1} g/cm^3 and 10^{-11} g/cm^3. The nuclei were probably formed with some neutron excess so that both neutron capture and β-decay were effective in determining relative abundances. The chain of formation followed a path such that the β-decay and capture probabilities were approximately equal. The abundance of nuclei of even atomic weight over those of odd atomic weight can be explained from the general features of the nuclear energy surface, regardless of the neutron excess at the instant of formation. A.

539.17 : 521.042

4977. A neutron-capture theory of the formation and relative abundance of the elements. ALPHER, R. A. *Phys. Rev.*, **74**, 1577–89 (*Dec.* 1, 1948).—There exists an inverse relationship between the relative abundance of nuclei in the universe and their neutron-capture cross-sections. On the basis of this correlation, a non-equilibrium theory of the formation of the elements is developed in which the elements

are built up by a process of successive neutron captures. According to this theory, the primordial material was a gas of neutrons only. As the universe expanded, neutrons decayed to protons and electrons; the capture of neutrons by protons then led to deuterons. These nuclei in turn captured neutrons, and progressively heavier nuclei were formed. The neutron content in these nuclei was controlled by beta-decay between successive neutron captures. The physical conditions which are indicated for the period of element formation are inconsistent with a cosmological model of the early stages of the universe based on matter only. It appears that the early stage was probably a universe of radiation with a trace of matter present. According to this picture, the element-building process began 200–300 sec after the start of the expansion, at which time the temperature was of the order of 10^9 °K, and the density of matter was of the order of 10^{-3} g/cm^3. Because of the expansion of the universe, and because of the decay of neutrons, the production of elements must have been essentially complete in a time of the order of magnitude of the neutron decay lifetime. Preliminary calculations based on this theory successfully predict the observed relative abundance data. A.

539.17 : 778.3

Proposed method for measuring scattering of particle tracks. *See Abstr.* 5183

539.172.1

4978. A study of the interaction of protons with tritium. Taschek, R. F., Jarvis, G. A., Hemmendinger, A., Everhart, G. G. and Gittings, H. T. *Phys. Rev.*, **75**, 1361–5 (*May* 1, 1949).—Preliminary measurements of the scattering cross-section of tritium for protons and the reaction cross-section for $T^3(p,n)He^3$ have been made. A method of analysis for H in tritium samples is described. The neutron yield of the reaction is high and will make it a useful source; the threshold is sharp and can be used as a point on the energy scale of nuclear physics. Angular distributions for scattering and cross-sections for the reaction are given. A.

539.172.1

4979. An accurate determination of the threshold for the nuclear reaction $C^{12}(d,n)N^{13}$. Bonner, T. W., Evans, J. E. and Hill, J. E. *Phys. Rev.*, **75**, 1398–1400 (*May* 1, 1949).—The threshold for the production of neutrons from the bombardment of C^{12} by deuterons was found to occur at 328 keV. The Q value of the reaction calculated from this threshold is $-0{\cdot}281 \pm 0{\cdot}003$ MeV. From this Q value and other disintegration energies, the calculated mass difference between the neutron and proton ($n - H$) is 0·77 MeV. A.

539.172.1

4980. Theory of proposed reactions involving polarized protons. Wolfenstein, L. *Phys. Rev.*, **75**, 1664–74 (*June*, 1949).—The use of fast polarized projectiles in nuclear reactions provides a possible tool for studying the spin-dependence of nuclear interactions. In the first section general properties of such reactions are discussed. The following reactions involving polarized protons are shown to be possible: (*a*) production of polarized protons by the (n,p) reactions of N or He^3 using polarized thermal neutrons, (*b*) detection of polarization by means the Li^7 (p,α) α-reaction, and (*c*) production or dete tion by the resonance scattering of protons from H Considering these reactions alone and exploring t fundamental limitations on intensity, one finds th the intensity problem appears to be least critical (*c*) is used for both production and detection. T polarization effect usually depends on at least o parameter which does not affect or affects much l critically the unpolarized result. The polarizati effect caused by the spin-dependent Coulomb scatt ing is calculated and found to be $< 5\%$ for aton number $Z < 5$, except for special cases. Proto retain their polarization while being slowed down.

539.17

4981. The neutrons emitted in the disintegration lithium by deuterons. Green, L. L. and Gibso W. M. *Proc. Phys. Soc., Lond. A*, **62**, 407–15 (*Ju* 1949).—The photographic plate method has be used in an investigation of the neutrons from t reaction $_3Li^7 + {}_1D^2 \rightarrow {}_4Be^8 + {}_0^1n$. The results are general agreement with those of Richards, but sh the structure of the neutron groups more clear In particular, the shape of the broad group attribut by Richards to a level in Be^8 at $3{\cdot}0 \pm 0{\cdot}4$ MeV discussed in detail. The total energy release $15{\cdot}0 \pm 0{\cdot}15$ MeV, and evidence is put forward the existence of energy levels in Be^8 at 2·8 Me 4·05 MeV, 4·9 MeV and 7·5 MeV.

539.172.12 : 539.1

4982. The neutrons and gamma-rays from disintegration of C^{12} by deuterons. Bonner, T. W Evans, J. E., Harris, J. C. and Phillips, G. *Phys. Rev.*, **75**, 1401–6 (*May* 1, 1949).—The excitati curves for the production of γ-rays and neutro resulting from the bombardment of C by deuter have been determined over the deuteron energ 0·7 to 1·9 MeV. A careful study of the very narr γ-ray resonance occurring at 1·435 MeV has sho that the $\frac{1}{2}$-width of the resonance is 5·5 keV and t cross-section is 0·62 barn at resonance. Oth γ-ray resonances were observed at 0·91, 1·16, 1· and 1·73 MeV with cross-sections, respectively, 0·29, 0·34, 0·39 and 0·97 barn. No resonance the production of neutrons has been observed at, near, 1·435 MeV. Resonances for the production neutrons were observed at energies of 0·91, 1· 1·30, 1·62 and 1·76 MeV with the total cro section at resonance, respectively, of 0·12, 0·14, 0· 0·19 and 0·22 barn. The angular distributions of t neutrons have been studied; the distributions a quite complex and vary radically with changes in t bombarding energy. At 1·26 MeV there are abo 5 times as many neutrons at 160° as at 0° to t direction of the deuteron beam.

539.17

4983. Photo-induced reactions at 20 MeV. Moo D. L., Waddel, R. C., Fagg, L. W. and Tobin, R. Letter in *Phys. Rev.*, **74**, 1536 (*Nov.* 15, 1948). Reports 23 different activities obtained by bombardi various medium and heavy nuclei with X-radiati from a 20 MeV betatron. B.

539.17

4984. Nuclear photo-effect and isotopic numb Jensen, P. Letter in *Proc. Phys. Soc., Lond.*,

579–80 (*Dec.*, 1948).—The 2 curves (σ *v.* Z) and ($N - Z$) *v.* Z) are exactly parallel, except at S^{32} and Ti^{46}, for nuclei up to $Z = 37$. Beyond this there is no clear correlation. (σ is the γ–n cross-section for lithium γ-rays.) The simplest suggestion, that the binding energy alone accounts for the parallelism, is discounted, although some general feature of the nuclear structure would seem to be responsible.

G. J. K.

539.172.4

4985. Disintegration of He^3 and N^{14} by thermal neutrons. Coon, J. H. and Nobles, R. A. *Phys. Rev.*, **75**, 1358–61 (*May* 1, 1949).—Cross-sections for the n–p reactions induced in He^3 and N^{14} by thermal neutrons have been determined by detecting the disintegrations in a proportional counter. The values obtained are 5 040 ± 200 and 1·76 ± 0·05 barns. A.

539.172.4

4986. The total cross-section of the He^3 nucleus for slow neutrons. King, L. D. P. and Goldstein, L. *Phys. Rev.*, **75**, 1366–9 (*May* 1, 1949).—Using the slow neutrons available from the thermal column of an enriched U pile, the total cross-section σ of the He^3 nucleus was determined by the transmission method. To the precision of the data, σ obeys the $1/v$ law in the range of averaged neutron energies extending from about 0·001 to 0·03 eV. The product $\sigma_{He^3} \times v$) is found to be $(11{\cdot}2 \pm 0{\cdot}5) \times 10^6$ barns × meters × sec^{-1}. The possible theoretical implications of these results are briefly discussed in connection with the properties of the compound He^4 nucleus. A.

539.172.4

4987. Reactions induced by slow neutron irradiation of europium. Hayden, R. J., Reynolds, J. H. and Inghram, M. G. *Phys. Rev.*, **75**, 1500–7 (*May* 15, 1949).—A sample of Eu which had been subjected to slow neutron irradiation was analysed using mass spectrometric techniques. By using a modified isotopic dilution technique, i.e. adding a standard containing known relative abundances of normal Sm, Eu and Gd the complete chemical and isotopic analysis of the irradiated sample was obtained. Combining this nuclide composition and certain radioactivity measurements the thermal neutron cross-sections, $\frac{1}{2}$-lives and branching ratios of 5 of the Eu isotopes were calculated. The results were $\sigma_{151} = 5\,200$ barns, $\sigma_{152} = 3\,200$ barns, $\sigma_{153} = 240$ barns, $\sigma_{154} = 880$ barns, $\sigma_{155} = 7\,900$ barns, $T_{\frac{1}{2}}(152) = 9{\cdot}3$ years, $T_{\frac{1}{2}}(154) = 5{\cdot}4$ years, $T_{\frac{1}{2}}(155) = 1{\cdot}7$ years, K/β^- ratio for 9·2 hr. $Eu^{152} = 0{\cdot}22$, K/β^- ratio for 9·3 years $Eu^{152} = 2{\cdot}8$ and K/β^- ratio for 5·4 years $Eu^{154} < 0{\cdot}05$. All these results are believed to be good to ±15%. A.

539.172.4 : 614.8

The metabolic properties of the fission products and actinide elements. *See Abstr.* 5180

ATOM AND MOLECULE BEAMS . MESONS NEUTRONS 539.18

539.18

4988. On the possibility of detecting a particle with spin and a mass much smaller than that of an electron in an inhomogeneous field. Thibaud, J. *C.R. Acad. Sci., Paris*, **227**, 1223–5 (*Dec.* 8, 1948) *In French.*—The usual method of balancing energies is inaccurate and is incapable of detecting masses $\ll 10^{-3}$ m. The present note points out that such particles can have magnetic moments $\geqslant$ one Bohr magnetron and deduces the conditions for observability which are, mass $\ll 10^{-31}$ g, specific charge $\geqslant e/m$, absolute charge $\ll e$. A. H. W. B.

539.18

4989. On the disintegration of mesotrons. Wang, K.-C. and Jones, S. B. Letter in *Phys. Rev.*, **74**, 1547–8 (*Nov.* 15, 1948).—The behaviour of μ-mesons brought to rest in either 0·63 cm Pb plates or 0·081 cm Al plates in a cloud chamber is described. Of 20 stopping in Al plates, 12 showed electron-like decay products. Scattering measurements in further Al plates allowed the estimate of electron energy 52 ± 10 MeV for one of the decay particles. J. G. W.

539.18

4990. On the multiple production of mesons. Wataghin, G. Letter in *Phys. Rev.*, **74**, 975–6 (*Oct.* 15, 1948).—Assumptions leading to a descriptive picture of the multiple formation of mesons in nucleon-nucleon collisions are discussed in the light of experimental studies of the meson component at high altitude. The modification of the results of these assumptions when a fast nucleon collides with a nucleus are also indicated. J. G. W.

539.18

4991. The lifetime of the heavy meson. Richardson, J. R. *Phys. Rev.*, **74**, 1720–1 (*Dec.* 1, 1948).—Heavy mesons were produced by bombardment of a $^1_1$B in graphite target with 350 MeV α-particles in a cyclotron: 2 spiral channels, one sloping above and one below the mid-plane of the cyclotron, were mounted so as to accept negative mesons moving initially forwards from the target. The mesons were detected with photographic plates after undergoing deflections of π and 3π in the respective channels. The ratio of the numbers of mesons detected in the 2 cases was found, after correction for the geometrical factor (theoretically 3, actually 3·2 as found by a test with a Pu α-particle source placed at the target position), to correspond to a $\frac{1}{2}$-life of $\left(7{\cdot}7 \begin{smallmatrix} +2{\cdot}1 \\ -1{\cdot}5 \end{smallmatrix}\right) \times 10^{-9}$ sec for the $\pi \rightarrow \mu$ process. A. P. F.

539.18

4992. Production of π-mesons in nucleon-nucleon collisions. Foldy, L. L. and Marshak, R. E. *Phys. Rev.*, **75**, 1493–9 (*May* 15, 1949).—The cross-section for the production of π-mesons in nucleon-nucleon collisions is calculated at energies just above the threshold. The process is treated in complete analogy with photonic bremsstrahlung: the π-meson field is coupled to the nucleon and an empirical potential between the two nucleons ensures momentum and energy conservation. The nuclear potential is taken from the Berkeley experiments on n–p scattering at 90 MeV. In this treatment the symmetric scalar theory yields zero cross-section if the recoil of the nucleons is neglected. The cross-section obtained is several orders of magnitude < the cross-section obtained by Morette and Peng [Abstr. 1770 (1948)] on the basis of a field-theoretic approach. A.

539.18

4993. On the cosmic-ray meson and the nuclear meson. TANIKAWA, Y. Letter in *Progr. Theor. Phys.*, **2**, 220–1 (*Nov.–Dec.*, 1947) *In English.*—The decay of a vector nuclear force meson to a scalar cosmic-ray meson with lifetime of the order 10^{-8} sec is shown to lead to interaction of nucleons with the cosmic-ray meson, by way of virtual transformations to the nuclear force meson, of a magnitude in agreement with experimental evidence of negative meson capture. J. G. W.

539.18

4994. On the lifetime of mesons. URBAN, P. *S.B. Öst. Akad. Wiss., Abt. IIa*, **156** (*Nos* 3–4) 131–41 (1948) *In German.*—The mean lifetimes of a meson for decay into electron + neutrino are calculated for scalar, vector and pseudoscalar mesons. With the assumed interaction constants, and neglect of small terms, all 3 are the same. Numerical values of the lifetime and the corresponding mean free path are given for mesons of various masses and energies up to 10^6 MeV for comparison with cosmic-ray data. G. J. K.

539.18

4995. On the pseudoscalar theory of mesons. URBAN, P. *S.B. Öst. Akad. Wiss., Abt. IIa*, **156** (*Nos* 3–4) 143–54 (1948) *In German.*—With this theory there is calculated the cross-section for scattering by nuclei, the probability of absorption by nuclei with the emission of a photon and the mean lifetime before decay into an electron + neutrino. G. J. K.

539.18

4996. On the neutral meson. TAKETANI, M. *Progr. Theor. Phys.*, **3**, 349–55 (*Oct.–Dec.*, 1948) *In English.*

539.18

4997. The scattering of mesotrons in Pb. TRUMPY, B. AND ORLIN, J. *Bergens Museums Årb.* (*No.* 7) 1–9 (1943) *In English.*—A bank of counters in anti-coincidence was placed below a conventional 3-fold telescope of Geiger counters. From observations with a large and a small anticoincidence bank, the fraction of mesons scattered but not absorbed by a Pb screen is obtained. This fraction is shown to be considerable and important corrections to published absorption curves of the hard component in Pb are made. E. P. G.

539.18

4998. Note on the two meson hypothesis. HAYAKAWA, S. Letter in *Progr. Theor. Phys.*, **3**, 200–3 (*April–June*, 1948) *In English.*—The relation between light and heavy mesons is considered, assuming the respective masses $350\,m_0$, $200\,m_0$ and the neutral meson mass $140\,m_0$ which follows from these masses in the 2-body energy-momentum balance at decay. Using the estimated lifetime 5×10^{-8} sec, the coupling constant γ between the two mesons is given by $r^2/\hbar c \sim 10^{-17}$. The capture of the negative light meson is then considered in the 2 stages, light meson → heavy meson + neutral meson (neutral meson escapes with most of the energy), heavy meson + proton → neutron, with only slight excitation of the capturing nucleus. The capture probability so determined is about $\frac{1}{4}$ of that observ but the precision of calculation is not decis Reasons are given for expecting a rather long life the neutral meson. J. G.

539

4999. Meson tracks on plates exposed on Nilgiris. RAO, S. B. AND SUNDARACHAR, C. Letter in *Curr. Sci.*, **17**, 210 (*July*, 1948).—The quency of slow mesons at 7 000 ft altitude and g magnetic latitude 2·8° is observed to be 0·7 per c per day, using Ilford type B1 photographic pla 100 μ thick. E. P.

539.18 : 530.

5000. Theory of scattering [of mesons], allow for damping. GRIGOREV, V. I. *J. Exp. Theor. Ph USSR*, **18**, 937–40 (*Oct.*, 1948) *In Russian.*— general and exact solution is presented of the probl of scattering of mesons by free nucleons, allowing damping. It is shown that the constancy of number of scattering particles as well as the c servation of energy and impulse follow from t general solution.

539.18 : 530.

Divergence difficulty and mixed meson theo *See Abstr.* 4472

539.18 : 537.59

Mass and spin of the mesotron. *See Abstr.* 487

539.

5001. The scattering of fast argon atoms in arg gas. BERRY, H. W. *Phys. Rev.*, 75, 913–16 (*March* 1949).—Apparatus is described for the production A atom beams of energies of 500 eV to 3 500 eV a for the measurement of the elastic scattering of th beams in A gas at rest. Differential scattering cro sections are found and from them an interacti potential over a range of 0·6 to 1·2 Å is determin This is compared with the exponential repulsive te of the potential suggested by Buckingham for The agreement is within the experimental error.

539.

5002. Note on the distribution of secondary ioni tion produced by a neutron flux incident upon hydrogenous substance. CAPRON, P., CRÈVECOEUR, FAES, M. AND TAVERNIER, G. *Bull. Acad. Roy. Be Cl. Sci.*, **34** (*No.* 12) 906–29 (1948) *In French.*—The fl distribution due to thermal and epithermal neutro incident normally on the flat surfaces of paraffin a triplex blocks was studied, using thin Rh detecto with and without Cd screening. Ra–Be in a paraf wax "howitzer" was used as the source of neutro An empirical formula is derived, which gives t thermal neutron density as a function of de through the block, in terms of the diffusion len and total mean free path of the neutrons. T formula is used in calculating the secondary ionizati produced by neutrons in hydrogenous matt through the absorption of the radiations from t reactions $H(n,\gamma)D$ and $N(n,p)C$. Various values assumed for the diffusion length and mean free p of the neutrons. Tables and curves are given for t ionization dose at various depths in blocks of infin thickness and also for the radiation received behi shields of different thicknesses. L. R.

539.185

5003. On the integration of the integro-differential equation governing the phenomenon of the diffusion of thermal neutrons. AGOSTINELLI, C. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 140–3 (*Sept.–Oct.*, 1948) *In Italian.*—A solution is given in the form of a definite integral. L. P.

539.185

5004. An interpretation of the resonance scattering of neutrons by cobalt in terms of the Breit–Wigner equation. SEIDL, F. G. P. *Phys. Rev.*, **75**, 1508–18 (*May* 15, 1949).—The neutron transmission of a Co foil (8·67 mg/cm²) was measured for epithermal pile neutrons which were filtered through various thicknesses of B^{10}. The detector consisted of an annular BF_3 counter. As used for the transmission measurements this counter was set up to count only neutrons scattered by a second Co foil (9·55 mg/cm²). The counter sensitivity as a function of neutron energy was studied. Effective total cross-sections of 3 100 b and over were calculated from observed transmissions. By means of B^{10} absorption, a resonance was located at 108 ± 10 eV and this was associated with resonance scattering of the neutrons. The total resonance cross-section σ_0 was estimated to be 12 500 ± 1 250 b and the magnitude of the resonance scattering, expressed by $\gamma \cdot \sigma_s(E_r)$, was estimated to be $\sim 45\,000$ eV.b; here γ denotes the total level width and $\sigma_s(E_r)$ denotes the elastic scattering cross-section at resonance. The neutron transmission was calculated from the single-level Breit–Wigner equation for the case where scattering is the predominant process. This equation was written in a conventional form involving, besides energy dependence, the parameters Γ, R and j; where the neutron width is $\Gamma(E/E_r)^{\frac{1}{2}}$; where $4\pi R^2$ represents the scattering from the surface of the initial nucleus, and where j is the spin quantum number of the compound nucleus. Calculated transmissions agreed with experimental transmissions in two instances: (1) $\Gamma = 2{\cdot}0 \pm 0{\cdot}1$ eV, $R = +\,0{\cdot}93 \times 10^{-12}$ cm, $j=4$, and (2) $\Gamma = 5{\cdot}0 \pm 0{\cdot}5$ eV, $R = +\,0{\cdot}97 \times 10^{-12}$ cm, $j = 3$. However, the value $\sigma_0 = 12\,500 \pm 1\,250$ b is consistent only with $j = 4$. A negative R will mean that the minimum of the "dispersion" curve $\sigma_s(E)$ *v.* E occurs above the resonance energy E_r and such was found to be inconsistent with the data. Finally, mention is made of the similar scattering resonance which takes place in Mn, $E_r \simeq 300$ eV; here σ_0 lies between 4 000 and 5 000 b and $\Gamma \sim 10$ eV. A.

539.185

5005. Total neutron cross sections of compounds with different crystalline structures. WINSBERG, L., MENEGHETTI, D. AND SIDHU, S. S. *Phys. Rev.*, **75**, 975–8 (*March* 15, 1949).—The total neutron cross-sections of polycrystalline compounds, such as close-packed hexagonal ZnO, body-centred cubic TlBr, and face-centred cubic CaO and TiC were determined with the Argonne neutron velocity selector and neutron crystal spectrometer in the energy region of 0·001 to 1·0 eV. From the size of the cross-section peaks which are due to coherent scattering of neutrons the following scattering amplitudes were determined: Ca, $+\,0{\cdot}46 \times 10^{-12}$ cm; Ti, $-\,0{\cdot}25 \times 10^{-12}$ cm; Tl, $+\,0{\cdot}75 \times 10^{-12}$ cm. The previously reported value of $+\,0{\cdot}58 \times 10^{-12}$ cm for Zn was confirmed. The free atom scattering cross-section of Ca is 2·5 barns. A.

539.185

5006. The scattering of high energy neutrons by nuclei. FERNBACH, S., SERBER, R. AND TAYLOR, T. B. *Phys. Rev.*, **75**, 1352–5 (*May* 1, 1949).—The experiments of Cook, McMillan, Peterson and Sewell [Abstr. 2711 (1949)] on the cross-sections of nuclei for neutrons of about 90 MeV indicate that the nuclei are partially transparent to high-energy neutrons. It is shown that the results can be explained quite satisfactorily using a nuclear radius $R = 1{\cdot}37A^{\frac{1}{3}} \times 10^{-13}$ cm, a potential energy for the neutron in the nucleus of 31 MeV, and a mean free path for the neutron in nuclear matter of $4{\cdot}5 \times 10^{-13}$ cm. This mean free path agrees with that estimated from the high energy n–p cross-section, but the results are not sensitive to the choice of mean free path. A.

539.185 : 530.145.7

Analysis of nucleon-nucleon scattering experiments. *See Abstr.* 4483

539.185 : 530.145.7

Neutron-proton scattering with tensor forces. *See Abstr.* 4488

539.185 : 537.133

5007. On the magnetic moments of the neutron and proton. LUTTINGER, J. M. *Helv. Phys. Acta*, **21** (*No.* 6) 483–96 (1948) *In English.*—The magnetic moments of proton and neutron due to their interaction with a meson field are calculated by second order perturbation theory [see Abstr. 1701 (1949)]. Hole theory is used for the nucleons. The usual charge of mass divergencies met with in such a calculation are removed by using the fact that there exists a state for a Dirac particle in a homogeneous magnetic field H_0 with energy $E = Mc^2$, and the change in energy of such a state due to change of mass is independent of H_0. The terms $\propto H_0$ are finite and give the magnetic moment. The calculation follows that given for the electron [Abstr. 1694 (1949)]. A pseudoscalar meson field with pseudoscalar coupling is used: (pseudovector coupling gives the same result). The neutral, charged, and symmetric versions of meson theory are considered. The results do not agree with experiment. It is uncertain whether the error is in the model (pseudoscalar mesons) or in the use of perturbation theory.

H. McM.

539.185 : 537.133 : 530.145

Magnetic moment of the neutron. *See Abstr.* 4467

539.185 : 537.5

Neutrons in extensive showers. *See Abstr.* 4861–2

539.185 : 548.735

Secondary extinction and neutron crystallography. *See Abstr.* 5126

539.185 : 548.736.3

5008. Neutron diffraction study of the structure of ice. WOLLAN, E. O., DAVIDSON, W. L. AND SHULL, C. G. *Phys. Rev.*, **75**, 1348–51 (*May* 1, 1949).—The crystal structure of ice in which the location of the H atoms cannot be determined by X-ray means, has been studied by the neutron diffraction technique. The intensities in the neutron diffraction pattern from a powdered sample of heavy (D_2O) ice, maintained at − 90°C, were measured and compared with

the intensities which would result if ice possessed any one of 4 proposed structures. The O atom positions have already been determined from X-ray measurements and the proposed structures are considered here with respect to the location of the H (or D) atoms. The structures considered are (*a*) the Barnes model, in which the H atoms are midway between O atoms, (*b*) the Bernal and Fowler model which maintains a molecular grouping of two H atoms close (0·96 Å) to each O atom with a definite repeating orientation, (*c*) a model consisting of H molecules rotating about the O atoms as centres, and (*d*) the Pauling model, suggested on the grounds of a residual entropy at low temps., in which H molecules possess some randomness of orientation under the restriction that one and only one H atom lies on each of the lines joining one O atom to its neighbour. Structures (*a*), (*b*) and (*c*) are definitely ruled out by the neutron measurements while the Pauling structure agrees well with the measurement. A.

STRUCTURE OF SOLIDS 539.2

539.211

5009. Structure of solids. VII. Surface structure of solids. RAETHER, H. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I,*" 109–18 (1947) *In German.*—The effects of cold-working on the surface structure of metals are fully discussed, together with a review of methods of investigation using electron diffraction techniques to determine the granular form of surfaces. The effects of mechanical and electrolytic polishing of metallic surfaces are described, with particular reference to the potential energy states at the surface. Reference is made to some recent work on the effect of tempering on the surfaces of alkali-halide crystals. C. A. H.

539.213.1 : 666

5010. Structure of solids. V. Structure of glasses and synthetics. SMEKAL, A. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I,*" 84–101 (1947) *In German.*—The structural properties of glasses and of certain synthetic plastic materials which are amorphous and yet have some fluid properties, are described. Questions of the pseudo-crystalline structures assumed by some glasses, and of the manner in which some substances can assume either a glassy or a true crystal form are discussed, and reference is made to some technical advances. C. A. H.

539.213.1 : 666

5011. The nature of the glassy state and the behaviour of liquids at low temperatures. KAUZMANN, W. *Chem. Rev.*, **43**, 219–56 (*Oct.*, 1948).—Reviews and discusses theoretical problems connected with glasses and supercooled liquids, particularly of thermodynamic properties and the glass-transformation phenomena due to freezing-in of molecular configurations. Extrapolation of data on some glass-forming liquids suggests that the (equilibrium) entropy and enthalpy might fall below the crystal values well above absolute zero. This paradox is avoided by assuming that the height of the f energy barrier resisting crystallization decreases, that the resisting molecular diffusion proces necessary to reach equilibrium liquid configurat increase with falling temp. Below a "pseu critical" temp. the substance could then exist only crystal or glass, not as a (equilibrium) liquid. T explanation is consistent (though not quantitative with Mott and Gurney "micro-crystalline" struct of liquids. A comprehensive list of over 100 referen is included. G. G

539.214 : 54

Plasticity of crystalline substances. *See Abstr.* 5

539.2

5012. Study of self-diffusion and chemical react in solids with emanation as indicator. JAGITSCH, *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 11) 1- (1942) *In German.*—The advantages of Hah emanation method [*Naturwiss.*, **12**, 1140 (1924)] following physical and chemical changes involv solids are enumerated. The experimental method outlined and its application to polymorphic tra formation (γ–Al_2O_3 to α–Al_2O_3) and to self-diffusi in ionic conductors (Ag_2SO_4, $PbSO_4$, $CuSO_4$, ZnS $BaCl_2$) and to defect structures (Cu_2S, Ag_2S, C Mn_2O_3, Pb_3O_4, $Ca_3(PO_4)_2$) is discussed. Its relevan to reactions between a solid and a gas, or betwe two solids, is touched on. S. J.

539.2

5013. Thermodynamics of solids. V. Diffusion solids. BRAUNBEK, W. *FIAT Rev. German S* 1939–46) [*Off. Mil. Govt. Germany*] "*Physics Solids, I,*" 221–8 (1947) *In German.*—Meth involving the use of radio-active tracers are descri for such problems as the self-diffusion in Fe. Gase diffusion has been studied by an emanation meth due to Hahn. The diffusion of H_2 and D_2 throu Fe and Pd has been studied, and 2 new techniq for metal foils and alloys have been described. few measurements are recorded for diffusion in n metals. Theoretical problems treated include diffusion of atoms, ions, electrons and neutro through solids of various classes, special refere being made to the activation energies and therm dynamic conditions involved. C. A

539

5014. Structure of solids. VI. Structure of t films. RAETHER, H. *FIAT Rev. German Sci.* (1939– [*Off. Mil. Govt. Germany*] "*Physics of Solids,* 102–8 (1947) *In German.*—Thin films of metals non-metallic substances may be formed by mechan means, by electrolytic deposition, or by evaporat on to a substrate, usually glass, pyrex, or e celluloid. Electron and X-ray diffraction meth for structural investigation are reviewed, and most useful is considered to be a combination electron diffraction methods and the use of electron microscope. Diffuse X-ray diffract photographs are not evidence for the amorph nature of a thin film, since it is found that a struct known to be composed of small crystals yi similarly diffuse patterns. Hendus considers t Se and Sb may both be obtained in a truly amorph state by evaporation on to a celluloid sheet.

warming to about 160°C the Sb film can be changed to a crystalline structure with corresponding change in electrical conductivity and in X-ray diffraction pattern. It has also been found that the structure of certain Sn and Bi foils remains static even above the m.p. This is thought to be due to a thin oxide film on the surface, which by mechanical pressure inhibits the destruction of the metallic lattice. Details of the way in which the formation and structure of a thin film depends on the nature and temp. of the substrate, and on the ambient gases, is considered. Of technical interest is the work of Hass and Kehler on the structure of thin films of γ-Al_2O_3 formed by the anodic oxidation of Al. This substance is amorphous when formed, but assumes a crystalline structure above 650°C. C. A. H.

539.26/.27

5015. Structure of solids. I. Methods of structural investigation. GLOCKER, R. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 1–14 (1947) *In German.*—A review of German work up to 1946 is given. Recent improvements in X-ray diffraction techniques and in the use of the electron microscope are described. Crystal monochromators for X-rays have been used in the study of low-angle scattering and of the structure of fibres. It is found that the electron microscope is best used as an adjunct to more conventional methods of structural investigation. Brill *et al* [*Ann. Phys., Lpz.*, **34**, 393 (1939)] have claimed that under certain circumstances not only positions of atoms but also the distribution of electrons may be found by an extended Fourier analysis. The foil support material used in the determination of lattice constants by electron diffraction methods is discussed and LiF is suggested as a suitable standard. Reference is made to optical methods for the investigation of surfaces produced by etching, and for determining lattice imperfections after the introduction of rare-earth ions into the lattice of the material. The methods are all considered in relation to suitability for single crystals, polycrystalline materials, powders, amorphous solids and liquids. C. A. H.

539.264

5016. Application of X-ray analysis to the study of sintering: case of the cupro-nickels obtained by powder metallurgy. NGUYEN, T. C. *Ann. Radioélectricité*, **4**, 48–53 (*Jan.*, 1949) *In French.*—The sintering of compressed mixtures of Cu (99·72%) and Ni (99·60%) powders was followed by means of the high temp. camera previously described [Abstr. 3576 (1949)]. The variation of lattice parameter with composition [Abstr. 1793 (1934)] was confirmed, and the rate of diffusion as a function of powder size and temp. (up to 900°C) studied qualitatively. Diffusion is slowest for the composition CuNi, faster for alloys rich in Ni, fastest for alloys rich in Cu, which recrystallize. A. J. C. W.

539.27

5017. Electron diffraction investigation of thin alloy films of the system CuSn. EFENDIEV, G. A. *J. Tech. Phys., USSR*, **18**, 1159–65 (*Sept.*, 1948) *In Russian.*—Results are presented of an electron diffraction investigation of the structure of Cu-Sn alloys in thin films formed by evaporation and condensation in high vacuum. B. F. K.

539.27

5018. A device for polishing in vacuum with high speed polishing wheels and simultaneous inspection of surfaces by electron diffraction. COURTEL, R. AND LÉGER, R. *J. Rech. Cent. Nat. Rech. Sci.* (*No.* 7) 161–7 (1948) *In French.*—The device is incorporated into Trillat's electron diffraction tube and attached to the specimen holder in such a way that the specimen orientation control is not impeded. The polishing wheel is driven by a 700 c/s squirrel-cage motor situated in the vacuum with a speed of 45 000 r.p.m. The freshly formed surfaces give electron diffraction diagrams showing orientation due to the polishing process. It is proposed to study physico-chemical properties of such surfaces. A preliminary survey has shown that, e.g. a freshly polished mild steel surface shows no trace of oxide which immediately appears when air is admitted. H. M.

ELASTICITY . STRENGTH . RHEOLOGY
539.3/.8

539.3

5019. Mechanical properties of solids. I. Elasticity of solids. KÖSTER, W. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 119–25 (1947) *In German.*—A method of measuring Young's modulus and impression hardness due to Kappler is described, in which crossed cylinders of the material are compressed and the elliptical contact area is examined until it has become circular. The formulae involve a knowledge of Poisson's ratio for the material. Oscillatory methods for measuring elastic constants of solids have been fully reviewed, and low temp. measurements of the elastic constants of single crystals of several metals have been recorded. The influence of temp. and other factors on the properties of alloys is discussed. The general relation for metals, $\chi T_S/V \simeq$ const. (χ is compressibility, T_S is melting-point, and V is atomic volume), is criticized, and it is claimed by Biltz and Klemm that χ is simply related to the difference between the atomic and ionic volumes (the "electronic volume," V_E), since the graph of log χ against V_E is linear for several metals. C. A. H.

539.3 : 534.321.9

Wave propagation in solids. *See Abstr.* 4583

539.31 : 534.372

5020. The damping capacity of metals in transverse vibration. ENTWISTLE, K. M. *J. Inst. Met.*, **75**, 81–96 (*Oct.*, 1948).—The development is described of a method for the measurement of damping capacity at low stresses on specimens of uniform cross-section vibrating transversely in the "free-free" mode. The damping capacity of Al-rich alloys ranges between 0·0022 and 0·0035%. The discrepancy between these values and those for specimens of similar material in torsional vibration can be explained by the existence of transverse thermal currents in the former case. The changes of damping capacity

during ageing at room temperatures following solution treating and quenching were measured; in addition, a marked decrease in damping capacity resulted from precipitation at elevated temperatures after ageing for over 18 months at room temperature. A.

539.31 : 534.372

5021. The effect of grain-size on the damping capacity of alpha brass. ENTWISTLE, K. M. *J. Inst. Met.*, **75**, 97–106 (*Oct.*, 1948).—The effect was investigated in both torsional and transverse vibration. The results are in close agreement with Zener's prediction of a contribution to damping capacity in all three kinds of vibration by intercrystalline thermal currents, which was verified experimentally in longitudinal vibration [Abstr. 3930 (1939)]. A.

539.319

5022. Mechanical properties of solids. V. Internal damping of solids. BENNEWITZ, K. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 179–88 (1947) *In German.*—This concept which affects all transport properties of solids such as heat conduction and viscosity received much attention during the war. Experiments on many properties of solids as functions of time are recorded, especially on sodium silicate and Na-Ca glasses. The difference between thermal and diffusion damping, forced oscillations, resonance conditions, and general quantum conditions for the internal atomic arrangements of solids are fully discussed. C. A. H.

539.319

5023. On the experimental determination of the specific loss of energy of solid bodies by the method of coupled pendulums. KOVACS, A. *C.R. Acad. Sci., Paris*, **227**, 1019–20 (*Nov.* 15, 1948) *In French.*—A modification of the method of Le Rolland is described by which a single experiment furnishes the values of the 3 quantities required, and hence the value of the specific loss of energy (k). It is shown that measurements on the max. and min. amplitudes of successive beats are all that is required. The technique is being used to study the variation of k with temp. for certain high polymers. A. J. K.

539.32

5024. The elastic modulus and the fatigue limit. KAMMERER, A. *C.R. Acad. Sci., Paris*, **227**, 1144–5 (*Nov.* 29, 1948) *In French.*—The assumption of 2 coefficients of viscosity, together with a variation of elastic modulus with extent of strain, can explain both static and periodic mechanical properties, in tension and in bending, for such diverse materials as rubber, plastic materials and metals. L. G. C.

539.32

5025. Relation between residual strain energy and elastic moduli. ZENER, C. *Acta Cryst.*, **2**, 163–6 (*June*, 1949).—It is shown that the presence of residual strain energy necessarily results in a lowering of the overall tensile and shear moduli, and a quantitative relation is derived between the density of residual strain energy and the decrease in tensile and shear moduli. An interpretation is thereby given to the recent observations of Köster [*Z. Metall.*, **39**, 111 (1948)] that solute atoms of only a small solubility lower the tensile mdoulus when they are atomica dispersed.

539.32 : 5

5026. Elastic constants of calcite and sodiu nitrate. BHIMASENACHAR, J. *Proc. Indian Aca Sci. A*, **22**, 199–208 (*Oct.*, 1945).—Using the ne method of Bhagavantam and Bhimasenachar t elastic constants of calcite and sodium nitrate ha been determined. Values for calcite support existi data, but the values for sodium nitrate are new. W. R.

539.32 : 548

A modified method for the determination of elast constant of crystals. *See Abstr.* 5100

539.32 : 548

Elastic constants of ammonium chloride a ammonium bromide. *See Abstr.* 5101

539.374 : 537.312

5027. On the increasing electrical resistance metals caused by plastic deformation. LÜCKE, I *Nachr. Wiss. Göttingen* (*No.* 1) 27–30 (1948) *German.*—An association is sought between t amount of plastic deformation dl and the increa dp in electrical resistance ρ. It is found in the formu $dp = a - dl/l$. It is thought that the basic princip of plastic deformation is the formation and shiftin of dislocations. Some displacements are bound t in the space lattice and the changes in the characte istics of a material are suggested to be in consequenc and a function, of the number and arrangement these "bound up" dislocations. A final formula derived for the association between the characteristi in question. W.

539.37

5028. A general approach to the problem of visco deformations. COLONNETTI, G. *Atti Accad. Na Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **4**, 515–19 (*Ma* 1948) *In Italian.*—The treatment is analogous to th of plastic deformations. It is proved that any visco deformation may always be considered as the resulta of a deformation which does not change the stress and another which does not change shape a dimensions of the solid body. L.

539.374 : 548

5029. The plastic deformation and crystal orientati of thallium halides. SMAKULA, A. AND KLEIN, M. V *J. Opt. Soc. Amer.*, **39**, 445–53 (*June*, 1949).—Tl plastic deformation of cubic Tl halide crystals pr duced under pressure of a cone perpendicular to t crystal surface, shows two kinds of very sharp limited, raised patterns, namely, the "superficia and the "transmitted." In both of these pattern the shape, symmetry and position depend on t lattice orientation of the crystal with respect to t observation surface. The first appears around t press point in the form of radial wings. The secon develops on the opposite side of the press point a has a square or a rhombic shape. Characteristics the patterns are explained by the localized distortio of the single crystal around the press point into a aggregate of small crystals. The glide planes (T) the small crystals lie in the dodecahedron faces (110 and the glide directions (t), in the cubic faces (001 The superficial patterns can be applied to determi the crystal orientation within a few degrees. Inn

strains which are not permanent develop symmetrically around the press point. Under pressure of a cone, NaCl crystals show splitting along the dodecahedron faces (110), while under the same conditions, AgCl crystals give only diffuse patterns. A.

539.4.016

5030. Latent hardening in extended aluminum crystals. RÖHM, F. AND KOCHENDÖRFER, A. *Z. Naturforsch.*, **3a**, 648–56 (*Dec.*, 1948) *In German.*—Hardening is not confined to the active glide system, but extends to all systems. Single-crystal Al rods (0·4×6 cm) of various orientations were grown by slow lowering from a furnace of a graphite mould filled with fluid Al. The initial purity of Al was 99·9985%. The rods were extended about 15%, ordinarily by glide on a single active system, but in 2 crystals glide alternated between 2 active systems. Small sections parallel to the glide planes were then cut from the rods, and the shear stresses required to initiate glide in the active and the various inactive systems were measured. The original shear yield stress was ~ 160 g/mm², and the maximum increase after unit glide was $\sim 2\,000$ g/mm². Corresponding figures for commerical Al (99·5%) were 300 and 4 000 g/mm². To a first approx. the hardening for unit glide in the active system is a function only of the angle χ between the (active or inactive) glide planes and the axis of the rod: $\tau/\sin\chi \approx$ constant, where τ is the increase in shear stress required to initiate glide. Since the area of the glide planes is $\propto 1/\sin\chi$, the actual force required to overcome the hardening is constant for all glide systems; the numerical value after unit glide was 37 ± 3 kg. Gliding alternately on 2 active systems introduced complications; in particular the shift from one to the other was delayed until the resolved shear stress on the inactive system considerably exceeded that in the active system. This implies an exception to the "shear stress law." A. J. C. W.

539.434

5031. A theory for creep of ceramic bodies under constant load. GIBBS, P. AND EYRING, H. *Canad. J. Res. B*, **27**, 374–86 (*April*, 1949).—The plastic flow and elastic behaviour of ceramic materials is treated using a statistical mechanical relaxation theory. It is found necessary to treat creep as involving 2, and, in some cases, 3 relaxation mechanisms. The methods necessary for treating such non-Newtonian flow are developed here for creep for the first time. The results obtained are in accord with expectations on the basis of reports of others for flow at constant rate of loading and constant rate of strain for other materials. A.

539.5 : 548.0

Surface effects with single crystal wires of cadmium. *See Abstr.* 5102

539.53

5032. Mechanical properties of solids. III. Hardness of solids. PÖSCHL, T. AND BÜCKLE, H. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 144–53 (1947) *In German.*—This technically important subject still rests on a largely empirical basis. Comparative tests can be made by many methods but the precise properties being measured are not clear. The concept has been investigated both macroscopically and microscopically, and the Zeiss Hanemann micro-hardness tester (1941) enables extremely small surface areas to be examined, so that actual inhomogeneities of the surface may be measured, and a start made in the interpretation of the results in terms of the more recent ideas on the subject. C. A. H.

PHYSICAL CHEMISTRY 541

THERMO-CHEMISTRY 541.11

541.1

5033. On terminology and symbols in physical chemistry. VERSCHAFFELT, J. E. *Phil. Mag.*, **39**, 560–72 (*July*, 1948).—Remarks are made concerning a previous paper [Abstr. 1014 (1944)]. These relate to molecular weight, density and specific volume, latent heat, temp. and gas constant, and chemical reactions. The meanings to be attached to the expressions "physically pure" and "chemically pure" are discussed. L. S. G.

541.115

5034. The heats of formation of free CN and free CH_2, and the relationship between $D(CO)$, $D(CN)$ and $D(N_2)$. LONG, L. H. *Proc. Roy. Soc. A*, **198**, 62–81 (*July* 22, 1949).

541.115

5035. Difficulties in the application of molecular orbital theory to mesomeric ions. COULSON, C. A. AND DEWAR, M. J. S. *Disc. Faraday Soc.* (*No.* 2) 54–62 (1947).—The nature of the approximations used by Dewar in calculating heats of formation of π-complexes by Hückel's molecular orbital method is examined and the various simplifying assumptions are assessed. W. R. A.

PHASE EQUILIBRIUM 541.121/.123

541.121/.123

5036. Gas-liquid equilibria in hydrocarbon systems. NEDERBRAGT, G. W. *Appl. Sci. Res.*, **A 1** (*No.* 3) 237–48 (1948) *In English.*—The volatility of n-$C_{10}H_{22}$ contacted with H, CH_4, or C_2H_4 at 40° and 80° under pressures of 20 and 40 atmos. has been measured and also the amounts of contacting gas dissolved in liquid n-$C_{10}H_{22}$ under these conditions. The ratio of n-$C_{10}H_{22}$ in the gas and liquid phases gives the "equilibrium constant" (K). The influence of the density of the gas phase on K has been investigated. Two calculation methods, which enable equilibria of similar systems to be predicted, are discussed. W. R. A.

541.123.2

5037. Liquid-vapor equilibrium of ethanol-toluene solutions. KRETSCHMER, C. B. AND WIEBE, R.

J. Amer. Chem. Soc., **71**, 1293–7 (*May*, 1949).—The vapour pressure of ethanol has been determined from 25° to the boiling point. Densities at 25° and vapour compositions and pressures at 35 and 55° have been measured for solutions of ethanol in toluene. The results are quite consistent with the Gibbs–Duhem relation. The excess free energy and entropy and the heat of mixing have been calculated from these data. The excess entropy has negative values similar to those found in other systems containing alcohols. A simple empirical equation has been developed which represents the liquid-vapour equilibrium of alcohol-hydrocarbon systems quite accurately. Constants in this equation are presented for ethanol-toluene solutions and a number of systems previously investigated. A.

REACTION KINETICS 541.124/.128

541.124

5038. Chemical kinetics of bromine following neutron capture. HAMILL, W. H. AND WILLIAMS, R. R., JR. Letter in *J. Chem. Phys.*, **16**, 1171–2 (*Dec.*, 1948).—The distribution of Br^{80} (18 min) between addition to C_2H_4 and exchange with HBr in the gas phase has been investigated. A. J. M.

541.128.7

5039. Thermokinetical model of homogeneous periodic reactions. SALNIKOV, I. E. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 3) 405–8 (1948) *In Russian.*—The mechanism has been studied of "non-dying-away" chemical vibrations, e.g. of some periodic reactions where the reactants were continuously replenished. Reference is made to a suggestion of Frank–Kamenetski, according to which, in a homogeneous chemical system where two consecutive exothermic reactions $A \xrightarrow[(I)]{} X \xrightarrow[(II)]{} B$ take place, the latter of which has the greater energy of activation, there may originate interdependent vibrations of concentration and temp. ("thermokinetic vibrations.") The paper shows that certain conditions result in autovibrations being produced in such a system. F. L.

ELECTROCHEMISTRY 541.13

541.13

5040. On the applicability of Gibbs–Helmholtz's equation to diffusion cells [pile di concentrazione]. SCARPA, O. *Atti Accad. Naz. Lincei* (*R.C. Cl. Sci. Fis. Mat. Nat.*) **5**, 225–30 (*Nov.*, 1948) *In Italian.*—The equation is proved not to apply to cells consisting of 2 equal metallic electrodes immersed in solutions of different concentration of the same salt of the metal of the electrodes, or to cells which may be reduced to this simple type. L. P.

541.132.3

5041. *p*H response of glass electrodes. PERLEY, G. A. *Analyt. Chem.*, **21**, 559–62 (*May*, 1949).—The newer lithia-silica types of glasses show very rapid response to rapid and wide changes of *p*H in buffered solutions. The speed of response of th newer types of glass electrodes to changes of *p*H buffered solutions is such that it is consistent to u the newer types of high-speed electronic recorders an controllers in connection with these systems. I solution changes from a buffered to an unbuffere condition, the response of these glass electrodes actual *p*H changes is much slower than when th change is from one buffer to another of different *p*H Considerable errors may result unless thorou washing is employed when glass electrodes are use for measurements in unbuffered solutions after th electrode has been used in buffers, as in a pr standardization of the entire electrode-instrume assembly. In making measurements in sparing buffered solutions by means of glass electrode vigorous agitation should always be maintained the glass-solution interface. The lithia-silica typ of glasses are not as susceptible to drying influenc as are the Corning 015 types.

541.13

5042. Properties of electrolytic solutions. XXXI Conductance of several salts in ammonia at −34° by precision method. HNIZDA, V. F. AND KRAUS, C. *J. Amer. Chem. Soc.*, **71**, 1565–75 (*May* 19, 1949).— Apparatus and techniques have been developed whi permit of measuring the conductance of salts liquid ammonia solution with a high degree precision. The conductance of NaBr and of KC Br and KI have been measured to low concentratio at −34°. The experimental values have bee analysed by the method of Fuoss and values of th limiting conductance and the dissociation consta have been derived. In the dilute region over considerable range of concentration, the values co form to the Fuoss relation with mean deviatio varying between 0·011 and 0·034%. An improve seal is described by means of which Pt electrodes ma be introduced into apparatus constructed of Pyre glass. An effective manostat is described for contro ling the temperature of a liquid ammonia bath. Th solubility of KCl in liquid ammonia at −34° w determined to be 0·01651 as determined by th specific conductance of its solution.

541.133.0

5043. An amplifier for use with conductance bridge IVES, D. J. G. AND PITTMAN, R. W. *Trans. Farada Soc.*, **44**, 644–6 (*Sept.*, 1948).—An amplifier sensiti to a few μV is described: it incorporates an inte ference-suppressing device and is suitable for hig precision measurements under unfavourable co ditions.

541.133.1 : 532.7

Particle migration in liquids. *See Abstr.* 4545

541.13

5044. A consideration of the mechanisms of electr deposition reactions and overvoltage. FERGUSON, A. *Disc. Faraday Soc.* (*No.* 1) 50–7, *disc.* 127–40 (1947).— Work carried out by the author and co-workers fro 1920 onwards is reviewed briefly and some bas problems of electrode processes are set out. Th results of applying oscillographic technique to th problem of H overpotential are discussed and a not explicable on any modern theories previous presented. They may be explained by the theory tha

the potential of a H electrode is at all times and under all conditions determined by the activity of H ions and atoms at the electrode/solution interface, that is by the reaction $H \rightleftharpoons H^+ + e$. J. O'M. B.

541.135.5

5045. The behaviour of reversible electrodes in alternating fields. BREYER, B. AND GUTMANN, F. *Disc. Faraday Soc.* (*No.* 1) 19–26, *disc.* 43–50 (1947).—A theory is put forward for reversible depolarizing processes in the presence of a superimposed alternating field, the frequency of which is small compared with the relaxation time of the electrochemical process occurring. A method of calculation of the dynamic resistance and capacity of the system is given. It is shown that a plot of the a.c. through the electrolytic cell against the applied direct potential exhibits current maxima at the E_0 values of the particular ionic species undergoing discharge. A dropping Hg electrode was used. Application to organic redox systems is possible and the possibility of use in the determination of double-layer capacities and of the electrocapillarity zero is discussed. J. O'M. B.

541.135.5

5046. Diffusion and convection at electrodes. AGAR, J. N. *Disc. Faraday Soc.* (*No.* 1) 26–37, *disc.* 43–50 (1947).—Forced and natural convection in liquids are examined by dimensional analysis of the relevant hydrodynamic equations, and the method applied to diffusion and convection processes governing movement of a solute between an electrode and the bulk of a solution. Results are related to heat transfer in similar systems and experimental heat transfer data for a solid/gas system are used in the case of a vertical electrode in unstirred solution to calculate the thickness of the diffusion layer. The results are in agreement with observed values. Variation of the diffusion layer thickness with concentration is treated in stirred and unstirred solutions. In the first case independence of concentration is found, while in the second a slight dependence is found. J. O'M. B.

541.135.5

5047. Use of the cathode ray oscillograph in the measurement of metal areas and the kinetics of electrode reactions. HUTCHEON, A. T. AND WINKLER, C. A. *Canad. J. Res. B*, **27**, 353–60 (*April*, 1949).—A commercial type c.r.o. has been used in conjunction with 3 stages of d.c. amplification to give suitable voltage amplification in the range 0·001 to 1 V. The effect of traces of grease in diminishing the measured surface area of Ag amalgam has been observed. Curves are shown for the determination of Cd surface areas and rate of increase of Cd polarization. A.

541.135.5

5048. Recent developments in the study of hydrogen overpotential. BOCKRIS, J. O'M. *Chem. Rev.*, **43**, 525–77 (*Dec.*, 1948).—Comprehensive review surveying modern experimental technique, experimental facts, general equations at a working H electrode and the various detailed kinetic mechanisms of the H evolution reaction $2H^+ + 2e \rightarrow H_2$ at various electrode surfaces. The slow discharge reaction is not the general mechanism of H overpotential on various metals and appears unlikely on any but metals of highest overpotential. A table of distinguishing criteria for the various theories is given. Work should be particularly directed towards the diffusion of H through metals; the kinetics of atom combination reactions at solid surfaces; and the effect of light on the velocity of the H evolution reaction. 162 refs. J. O'M. B.

541.135.61

5049. The theory of concentration polarization. LEVICH, B. *Disc. Faraday Soc.* (*No.* 1) 37–43, *disc.* 43–50 (1947).—The velocity of approach of matter to an electrode is treated on a hydrodynamic basis and the results are applied to develop a quantitative theory of the boundary layer for an electrode of arbitrary form. This treatment is further applied to the electrochemical reactions on the electrode surface. Calculation of the diffusion currents and potential distribution for geometrically simple cases is carried out (for revolving disc, vertical plate and dropping Hg electrodes). Comparison with experiment shows good agreement. The treatment assumes that there is no noticeable overvoltage and that the solution contains an excess of a neutral electrolyte. J. O'M. B.

541.136 : 621.352

5050. The galvanic cell Na amalgam/NaOH/CuO. JEDLICKA, H. *Z. Naturforsch.*, **3a**, 669–70 (*Dec.*, 1948) *In German.*—The characteristics of the cell Na amalgam/10% NaOH/oxidized Cu are described. The potential is little dependent on the concentration of Na in the amalgam and the cell can be made to operate in the range 0·0003% to 23% Na, the optimum concentration being 0·2%. The cell with 0·0003% Na yielded a current of 0·2 A for 12 min before the potential fell appreciably from its initial value, 1·6 V. The self-discharge of cells with $< 0{\cdot}3\%$ Na occupies many days. Experimental details are given. J. O'M. B.

541.138

5051. Kinetics of rapid electrode reactions. RANDLES, J. E. B. *Disc. Faraday Soc.* (*No.* 1) 11–19, *disc.* 43–50 (1947).—A method of investigation employing the application of an alternating potential of small amplitude to a micro-electrode at which the relevant electrode process is occurring is developed and the system is compared to an electrical equivalent of a capacitor and resistor in series. The measured values of these are used to calculate the rate constant of the reaction. A dropping Hg-amalgam microelectrode is used and rate constants for discharge of some metal ions are compared. A marked slowing down of rapid electrode reactions by addition of surface-active colloids to the aqueous solution was observed. J. O'M. B.

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18

5052. Directing effect of different ions on anisotropic colloids. THIELE, H. AND LÜCK, H. *Z.*

Naturforsch., **3b**, 393–402 (*Nov.–Dec.*, 1948) *In German*.—Anisodiametric sol particles can be directed either by surface-active substances or by phase boundaries, or by electrolytes. Both measured and calculated diffusion potentials of the ionogenic substances afford a relation between the charge of the gel boundary, limited by the different diffusion velocities of the ions, and the sign of the double refraction. The particles in the sol are directed radially or tangentially—by attraction or repulsion according to the positive or negative charge of the gel boundary—and fixed progressively in this position. There are 8 tables of data and 6 diagrams. H. H. HO.

541.18.047.3

5053. The effect of ultra-violet light on colloidal gold. BANERJI, B. K. Letter in *Curr. Sci.*, **17**, 332 (*Nov.*, 1948).

541.182 : 535.345

Optical transmission of a colloidal solution in a magnetic field. *See Abstr.*.4660

541.182.5

5054. Interaction of colloidal particles. I. Particular application to parallel plates. LEVINE, S. *Trans. Faraday Soc.*, **42 B**, 102–17 (1946).—An attempt is made to explain the long-range forces which cause plate-like colloidal particles (e.g. WO_3, soap micelles) to lie parallel, at distances of hundreds or thousands of Å apart. The free energy of interaction of 2 such charged colloidal particles is calculated, and the condition introduced that this shall be a minimum with respect to the surface density of adsorbed ions. It is not necessary to take van der Waals' forces into account. S. J. G.

541.182.5

5055. Long distance forces acting between colloidal particles. VERWEY, E. J. W. AND OVERBEEK, J. TH. G. *Trans. Faraday Soc.*, **42 B**, 117–31 (1946).—The free energy of an electrical double layer system is calculated as the total amount of work associated with the gradual discharge of all the ions in the system, including those responsible for the surface charge; the method is applied to the interaction of 2 spherical particles. The van der Waals attraction potential is also taken into account, and for distances of the order 500 Å is found to approach a r^{-7} law. For particles of colloidal dimensions, the calculation reveals the presence of a feeble attractive force at distances of 500–1 000 Å. S. J. G.

541.182.5

5056. Swelling stresses in anisotropic cylinders. WARBURTON, F. L. *Trans. Faraday Soc.*, **42 B**, 151–4 (1946).—The mechanical stresses set up in cylinders of hygroscopic gels due to the anisotropy of transverse swelling are considered for small changes in the amount of adsorbed liquid. It is shown that these result in a small change in the slope of the isotherm, and that a quasi-equilibrium is attained in the centre by mechanical forces rather than by absorption of the liquid. The final equilibrium with a uniform distribution of liquid through the cylinder is obtained when plastic flow releases the swelling stresses, and the change from quasi- to final-equilibrium will be much slower than the establishment of the quasi-equilibrium. S. J. G.

541.183

5057. The molecular adsorption areas of hydrocarbon gases on charcoal. NAY, M. A. AND MORRISON, J. L. *Canad. J. Res. B*, **27**, 205–14 (*April*, 1949).—The low temp. adsorptions of methane, ethane, propane, normal butane, isobutane, acetylene, ethylene and N on a series of coconut charcoals of different degrees of activation were determined. Langmuir isotherms were obtained in every case. The measurements indicate horizontal orientation of the hydrocarbon molecules on the charcoal surface. By comparing the maximum number of millimoles adsorbed for each gas on each charcoal with the respective maximum number of millimoles of N adsorbed, and by assuming a molecular adsorption area of 16·2 Å² for N, the following average molecular adsorption areas were obtained: methane—19·4, ethane—25·9, propane—36·0, normal butane—42·1, isobutane—47·4, acetylene—19·8, and ethylene—23·1 Å². A

541.183

5058. The adsorption of gases SO_2, NH_3, CO_2 and N_2O on BaF_2 crystals. CRAWFORD, V. A. AND TOMPKINS, F. C. *Trans. Faraday Soc.*, **44**, 698–708 (*Sept.*, 1948).—The adsorption of SO_2, NH_3, CO_2 and N_2O on BaF_2 crystals has been measured at various temps. between −78 and 119°c; from these isotherms heats of adsorption have been obtained using the Clausius-Clapeyron equation and the B.E.T. equation. The decrease of heats with coverage found experimentally is discussed and compared with those expected theoretically. Variation in adsorption potential over the crystal surfaces have been calculated in an approximate manner and the significance of these discussed from the viewpoint of the applicability of the B.E.T. multilayer theory. A

541.183

5059. Adsorption by montmorillonite, and its relation to surface adsorption. MACEWAN, D. M. C. Letter in *Nature, Lond.*, **162**, 935–6 (*Dec.* 11, 1948).—The author's results [*Trans. Faraday Soc.*, **44**, 349 (*June*, 1948)] for the swelling caused by adsorption of organic liquids by montmorillonite are considered with reference to the questions: (*a*) Why do the organic molecules penetrate? (*b*) Why is the expansion limited in extent? A composite curve (*I*) of potential energy against distance of separation of montmorillonite sheets is plotted from 3 other curves: (1) the lowering of surface-free energy calculated from the data of Bangham and Mosallem for adsorption on mica [Abstr. 2731 (1938)], (2) van der Waals' attraction (3) electrostatic attraction assuming there is only one layer of ions between the sheets. *I* shows a min. at 2 adsorbed molecular layers, as found by experiment. S. J. G.

541.183

5060. The swelling of cellulose xanthate gels in dilute salt solutions. VERMAAS, D. AND HERMANS, J. J. *Rec. Trav. Chim. Pays Bas*, **67**, 983–97 (*Nov.*, 1948) *In English*.—A theoretical relationship between the degree of swelling of a polymer network (isotropic cylindrical cellulose xanthate viscose filaments) bearing ionogenic groups, and the concentration of

he electrolyte in the swelling medium (various salt solutions) is developed, on the assumptions of a Donnan equilibrium between the gel and the swelling medium and of a modified Flory–Rehner equation relating the free energy of dilution and the degree of swelling. The relationship gives results in good agreement with those obtained experimentally, proving beyond doubt (from the slopes of the swelling curves relating the degree of swelling and the salt concentration of the swelling medium) that the network consists of short chains. There is, however, uncertainty concerning the specific lyotropic influence of the ions present on the slopes of the swelling curves. The curves deviate from linearity with highly swollen systems. J. G.

541.183

5061. On the adsorption of metal ions on metal surfaces. ERBACHER, O., HERR, W. AND WIEDEMANN, M. *Z. Naturforsch.*, **3a,** 637–45 (*Dec.*, 1948) *In German.*—This is studied by means of radioactive indicators (ThB, ThC and UX_1), mixed with Pb^{2+}, Bi^{3+} and Th^{4+} ions which were adsorbed on Ag, Au and Hg surfaces. Apparatus for adsorption experiments on Hg is described in detail. The other metals were cleaned by emery paper. The activity after removal of the electrolyte was measured by means of γ or β electroscopes. The results show clearly that an adsorption isotherm of the Ostwald–Freundlich type $a = \alpha c^{1/n}$ where a is the quantity adsorbed, c the concentration in the electrolyte after adsorption and α and n are constants. A physical interpretation of these constants is given in the light of a detailed consideration of the experimental results, to which, it is stated, a Langmuir isotherm could definitely not be fitted. H. M.

541.183

5062. Diffusion and swelling of high polymers. I. The swelling and solution of a high polymer solid considered as a diffusion process. HARTLEY, G. S. *Trans. Faraday Soc.*, **42 B,** 6–11 (1946).—Mainly theoretical. The variation of the diffusion coeff. with the concentration of the solution of polymer in the liquid must be taken into account. An experiment is described which demonstrates the real movement of the swollen polymer as a whole during swelling. S. J. G.

541.183

5063. Diffusion and swelling of high polymers. II. The orientation of polymer molecules which accompanies unidirectional diffusion. ROBINSON, C. *Trans. Faraday Soc.*, **42 B,** 12–17 (1946).—A cellulose acetate sheet was mounted between microscope slides, and unconstrained between glass strips so that it could swell in one direction only; the swelling was measured by a scale incorporated in the sheet, and orientation was detected by a polarizing microscope. The results are described. S. J. G.

541.183.2

5064. Phenomena arising from the adsorption of salts by mercury. POTAU, M. *An. Real. Soc. Esp. Fis. y Quim.*, **44,** 445–56 (*July–Aug.*, 1948) *In Spanish.*—When an alkaline halide crystal crosses the limiting surface between Hg and water, it shows a zone of greater solution at the metal level. This, the author believes, is due to the intense adsorption of the salt by the surface of the mercury. The violent motion associated with this phenomenon he believes to be due to the capturing of salt molecules by the mercury and the rush of replacement molecules from the crystal surface accelerates the dissolution of the surface adjacent to the mercury. D. F. M.

541.183.25

5065. Adsorption of water by polymers: analysis in terms of a simple model. HAILWOOD, A. J. AND HORROBIN, S. *Trans. Faraday Soc.*, **42 B,** 84–93 (1946).—A new adsorption isotherm has been derived on the basis of the following model: the adsorbed water exists partly in simple solution and partly combined as hydrate with a definite unit of the fibre molecule; it is then assumed that dissolved water, unhydrated molecules and hydrated molecules together form a single solid phase with the properties of an ideal solution. The isotherm is $Mr/1\,800 = \alpha h/(1 - \alpha h) + \alpha\beta h/(1 + \alpha\beta h)$, where r = gm of water adsorbed per 100 gm of polymer at relative humidity h; M = mol. wt. of polymer; α and β are constants. This reproduces satisfactorily the experimental data for adsorption on wool, hair, silk and keratin. [The assumption of an ideal solution is criticized by Gee and Barrer.] S. J. G.

ATOMIC THEORY 541.2

541.265

5066. The relations of the parachor to the critical values of temperature and volume. TEIGE, K. *Bull. Int. Acad. Tchèque Sci.*, **46,** 77–82 (1945) *In English.*—An expression for the parachor P is obtained in terms of the critical temp. and volume, the density of the liquid and constant K of the Eötvös equation; putting $K = 2{\cdot}1$, the value of P thus calculated shows good agreement with the experimental value for a number of liquids. S. J. G.

CHEMICAL STRUCTURE 541.4/.6

541.57

5067. Approximate method for the construction of molecular diagrams according to the molecular orbital technique. DAUDEL, P., DAUDEL, R. AND VRŒLANT, C. *C.R. Acad. Sci., Paris,* **227,** 1033–4 (*Nov.* 15, 1948) *In French.*—The bond order has already been found by spin technique to depend essentially on the orders of adjacent bonds, and bond orders can therefore be determined as a function of the others. In this paper, similar data have been calculated by the orbital method. The approximation is facilitated by tabulating data for each type of bond, from which diagrams for complex molecules may be readily constructed. Two examples of molecules with 5 homocyclic 6-membered rings are included. H. H. HO.

541.57

5068. Carbon-carbon and carbon-hydrogen bond energies. GLOCKLER, G. Letter in *J. Chem. Phys.*, **16,** 842–3 (*Aug.*, 1948).—When the force constants

k(CC) and k(CH) for aliphatic structures are plotted as a function of internuclear distance R(CC) and R(CH), the larger force constants are found for the shorter bonds. For calculation of the corresponding bond energies D(CC) and D(CH) there are only 2 points known at present on each of the D(CC) : R(CC) and D(CH) : R(CH) curves, and in the calculations now recorded, the other points for C_2H_2, C_2H_4, C_2H_6 have been found by dividing the corresponding atomic heats of formation (Q_a values) in such a manner that both types of curve D(CC) : R(CC) and D(CH) : R(CH) would have the same kind of curvature as the corresponding k(CC) : R(CC) and k(CH) : R(CH) curves. H. H. HO.

541.57 : 539.132

Molecular orbital theory of chemical valency. *See Abstr.* 4915–16

541.6

5069. The theory of the structure of free radicals. COULSON, C. A. *Disc. Faraday Soc.* (*No.* 2) 9–18 (1947).—A review of the theoretical calculation of structure and reactivity of free (saturated) alkyl radicals and of free (unsaturated) aromatic radicals. Different terminologies and symbols used in studies of aryl radicals are compared; the main difficulties in current theories are indicated; and future developments are outlined. W. R. A.

541.64

5070. The determination of macromolecular configurations in dilute solution by light scattering. DOTY, P. M., AFFENS, W. A. AND ZIMM, B. H. *Trans. Faraday Soc.*, **42 B**, 66–81 (*March*, 1948).—The ratio of the intensities of monochromatic light scattered at approx. 45° and 135° (I_1 and I_2) from the incident beam traversing polystyrene solutions has been investigated particularly in regard to the dissymmetry coeff., $[q] = (I_1/I_2) - 1$. The value of $[q]$ at infinite dilution is termed the intrinsic dissymmetry coeff. and is a molecular constant from which particle size may be characterized with greater exactitude than by means of intrinsic viscosity. W. R. A.

541.64

5071. The dimensions of charged long chain molecules in solutions containing electrolytes. HERMANS, J. J. AND OVERBEEK, J. TH. G. *Rec. Trav. Chim. Pays.-Bas*, **67**, 761–76 (*Nov.*, 1948) *In English.*—If a long chain molecule in a solution carries electric charges, the statistical coil is inflated, and the average square of the distance between the ends of the chain is $>$ in the uncharged state. For a number of properties the determining factor is the value of $\Sigma_k(r^2_k)_{av}$, where r_k is the distance between the k'th link in the molecule and the centre of gravity. This quantity $\propto$ (effective radius)^2 and is related to (distance between the ends)^2 by a simple formula, provided the radius of the coil $\ll$ the length of the extended chain. The electrical free energy of the molecule is derived as a function of effective radius on the assumption that no electrolytes are present. This free energy determines in its turn the average dimensions of the coil. A similar theory is developed for charged polymer molecules in the presence of electrolytes. The change of the effective radius with the charge on the polymer and the concentration of the electrolytes is calculated. In the limit of high electrolyte content the equilibriu between the interior and the exterior of the polym coil may be considered as a Donnan equilibrium.

541.6

5072. Relations between refraction, density a structure of series of homologous hydrocarbon SMITTENBERG, J. AND MULDER, D. *Rec. Trav. Chi Pays.-Bas*, **67**, 813–38 (*Nov.*, 1948) *In English.*—A empirical formula for relating the physical constan of pure hydrocarbons belonging to a homologo series is developed. The formula follows the ty $x = x_\infty + K/(c + Z)$, where x is the physical consta of a hydrocarbon containing c C atoms, x_∞ the lim of this physical constant at an infinite number of atoms, and K and Z empirical constants characteris for the series. Formulae for refraction and densi at 20°C are given for the 5 series n-alkanes, n- alkenes, n-alkylcyclopentanes, n-alkylcyclohexane and n-alkylbenzenes. Linear relations between t series are traced and comparisons are drawn. Usi the graphs the density or refraction of a compou may be predicted if one or the other constant known, or a compound of known density and r fraction but of unknown molecular weight may identified providing it is a member of one of the series. B. E.

CHEMICAL APPARATUS 542.1/.7

542.

5073. The theory of molecular distillation and experimental verification. BRADLEY, R. S. A SHELLARD, A. D. *Trans. Faraday Soc.*, **45**, 501 (*June*, 1949).—The theory of molecular distillati for binary mixtures is discussed, and is shown to applicable to measurements on mixtures of norm hexadecane with (*a*) normal tetradecane and (*b*) n mal pentadecane. Values of the vapour pressure (*a*) and (*b*) have been determined at 40 and 46 respectively.

CHEMICAL PROCESSES 542.9

542

5074. The first isolation of plutonium. CUNNIN HAM, B. B. AND WERNER, L. B. *J. Amer. Che Soc.*, **71**, 1521–8 (*May*, 1949).—The isolation chemically pure Pu and the preparation of the fi pure compounds of this element are describe Methods are described for the preparation a purification of Pu compounds on a 1–30 μg sca The specific alpha activity of Pu^{239} was determined weighing μg samples of plutonium oxide, and t value $7{\cdot}1 \pm 0{\cdot}1 \times 10^4\,\alpha$ counts per min per (in a 2π geometry counter) found. The $\frac{1}{2}$-life of t isotope Pu^{239} has been computed from speci activity and counting yield measurements to 24 300 ± 370 years. It is shown that the +4 state a stable oxidation state of Pu. Approximate sol bilities of Pu iodate, ammonium plutonium fluoric

Pu "hydroxide" and Pu peroxide have been determined. The colours of these compounds and of Pu oxide have been noted. A.

CHEMICAL ANALYSIS 543/545

545.82

5075. Emulsion calibration scale for quantitative spectroscopic analysis. HUGHES, H. K. AND MURPHY, R. W. *J. Opt. Soc. Amer.*, **39**, 501–4 (*June*, 1949).

545.82

5076. Applications of chemical concentration by organic reagents to spectrographic analysis. MITCHELL, R. L. AND SCOTT, R. O. *Spectrochim. Acta*, **3** (*Nos* 3–4) 367–78 (1948) *In English.*—Concentration of trace elements by organic precipitants (mixture of 8-hydroxyquinoline, tannic acid and thionalide) has extended the range for spectrographic determination. Complete recovery of Co, Ni, Mo, Sn, Pb, Zn, Cr, V, Ti, Be and Ge in a matrix of Al_2O_3 has been accomplished; alkalis, alkaline earths and phosphate have been eliminated. W. R. A.

545.82

5077. Evaluation of accuracy in photometric analysis. ARYES, G. H. *Analyt. Chem.*, **21**, 652–7 (*June*, 1949).—In light absorption spectrometry, plotting the data in the form of absorptancy against logarithm of concentration has important advantages over other plotting methods. For many instruments and operating techniques, the optimum range can be defined by inspection of the curve, as it is the concentration range in which it has its steepest slope. The maximum attainable accuracy is easily derived from the slope of the curve; the very flat portions of the curve at low and at high absorptancy emphasize the importance of selection of proper range if best accuracy is to be realized. Various methods of accomplishing measurement in the optimum range are discussed. For systems conforming to Beer's law, maximum accuracy is attained, with the instruments mentioned, when the absorptancy is about 63%, although the errors are not much larger in the absorptancy range 40 to 80%. In the commonly used calibration method, conformity to Beer's law is neither assumed nor required, and the evaluation of optimum range and maximum accuracy from the calibration curve is valid whether Beer's law is followed or not. Numerous instances are cited from the literature, in which the claims for range and accuracy are erroneous. A.

545.82

5078. Factors affecting accuracy in spectrographic analysis. MILBOURN, M. *Spectrochim. Acta*, **3** (*Nos* 3–4) 267–77 (1948) *In English.*—Methods of expressing accuracy are briefly discussed, and the factors which introduce errors are reviewed. S. T. H.

545.82

5079. Quantitative spectrographic analysis by spark excitation of metallic oxides. MILBOURN, M. AND HARTLEY, H. E. R. *Spectrochim. Acta*, **3** (*Nos* 3–4) 320–6 (1948) *In English.*—A new technique for using spark spectra is described, the metallic oxide being finely ground and contained in the lower electrode. The ejection of the material into the discharge is probably due to electrostatic repulsion. A considerable amount of the powder can be got into the discharge, making it arclike in character. A. H.

545.82

5080. Some improvements in the technique of spectrographic analysis of high purity materials. SMITH, D. M. AND WIGGINS, G. M. *Spectrochim. Acta*, **3** (*Nos* 3–4) 327–40 (1948) *In English.*—A survey article in which details are given of various refinements of methods now employed in spectrographic analysis of high purity materials. Attention is drawn to the use of the C arc in steam when dealing with the rare earth oxides, and the use of a concave mirror vice a lens for slit irradiation. A. H.

545.82

5081. A method of spectral analysis applicable to small traces of impurities in metals. ORSAG, J. *Spectrochim. Acta*, **3** (*Nos* 3–4) 341–5 (1948) *In French.*—As an example of the estimation of a volatile impurity in a metal, Na was determined in Al after calibrating line densities with 3 samples containing (by chemical analysis) from 0·01 to 0·06% Na. These were sparked separately, and again with one electrode of pure Al to give ½ the previous Na concentrations. The line densities plotted against Na concentration lay on a straight line through the origin, and Na could thus be estimated down to 0·0005%. S. T. H.

545.82

5082. Contribution to the analysis of traces in non-ferrous (metals). SEMPELS, G. *Spectrochim. Acta*, **3** (*Nos* 3–4) 346–53 (1948) *In French.*—Bi and Tl are separated from alloys and residues, especially those containing Pb, Zn or Cd, by fusion with litharge and a reducing flux. The Pb button is analysed spectrographically for Bi and Tl. For the determination of Ni and Co in electrolytic Zn these impurities are separated chemically, mixed with a known amount of ZnO and estimated spectrographically. S. T. H.

545.82

5083. Infra-red absorption analyses used in control of a pilot-plant process. FRY, D. L. *J. Opt. Soc. Amer.*, **39**, 402–5 (*May*, 1949).

545.82

5084. The spectrographic examination of localized heterogeneity in metals. OLDFIELD, J. H. *Spectrochim. Acta*, **3** (*Nos* 3–4) 354–6 (1948) *In English.*—Details are given of methods used for increasing the amount of sample affected by a spark discharge, thus minimizing errors due to local variations in composition. Details are also given of the method used (micro-spark technique) for reducing the area, in order that detailed study may be made of local variations. A simple form of electrode holder, giving accuracy in gap setting for micro-spark work, is described. A. H.

545.82

5085. Spectrographic determination of niobium and tantalum. HERMAN, P. *Spectrochim. Acta*, **3**

(*Nos* 3–4) 389–96 (1948) *In French.*—The metals are separated as pentoxides and spectrographed in a d.c. arc. Less than 20 mg of pentoxides is sufficient for the determination, to 1% accuracy, in samples containing from 1% to 99% of Nb and Ta. Traces of Ti and W may be present. S. T. H.

545.82 : 535.343.4

5086. Microwave spectra and chemical analysis. Dailey, B. P. *Analyt. Chem.*, **21**, 540–4 (*May*, 1949). —Absorption spectroscopy in the microwave region offers a new and useful tool in chemical analysis and process control. Molecular absorption spectra in the microwave frequency range are usually due to molecular rotation. To aid in understanding these spectra the relevant principles of molecular dynamics are discussed. The microwave spectrograph possesses extreme resolution, permitting actual absorption line shapes to be observed. The use of a single resolved molecular rotation line for quantitative analysis of an organic molecule in a complex mixture is proposed. The limitations of this analytical technique due to low intensities, the presence of only a small permanent electric dipole moment, excessive chemical reactivity of the absorption cells, etc., have been explored. The advantages and disadvantages of microwave spectroscopy in various applications are contrasted with those of the mass spectrometer and the infrared instruments. Molecular rotational spectra are characteristic of the molecule as a whole and do not possess features, as do vibrational spectra, characteristic of individual groups of atoms within the molecule. The extreme resolution available suggests that microwave techniques might be suitable for isotopic analyses in some instances. A.

545.82

5087. A general method for quantitative spectr chemical analysis. Addink, N. W. H. *Rec. Tra Chim. Pays-Bas*, **67**, 690–6 (*Nov.*, 1948) *In English.* Using the straight portion of the characteristic cur (for the photographic emulsion employed) a roug estimate is obtained for the concentration of t element being studied. A more exact estimate then obtained by successive additions of the elemer The method is also claimed to be reasonably accura for cases of high concentrations. A.

545.8

5088. A mass spectrometer for continuous g analysis. Hunter, J. A., Stacy, R. W. and Hitc cock, F. A. *Rev. Sci. Instrum.*, **20**, 333–6 (*May*, 194 —An instrument for recording continuously t relative abundance of gases in a 3-component mixtu is described. High accuracy of analysis has be sacrificed in favour of high speed response since t instrument was designed primarily for use in t investigation of respiratory problems. An insta taneous change in gas composition will appear the record with a lag of $< 0{\cdot}2$ sec and will requi approx. $0{\cdot}1$ sec to settle on this new value.

545.

5089. Adsorption analysis of high molecular su stances. Claesson, S. *Ark. Kemi. Min. Geo* **26 A**, *Paper* 24, 29 *pp.* (1948) *In English.*—High mo cular substances are adsorbed at a slow rate and small amount, the amount decreasing with increasi molecular weight. Advantages of the method a discussed by comparison of results with data deriv from other measurements and extensions of t method to purification and preparative procedur are indicated. W. R.

CRYSTALLOGRAPHY 548

548.0

5090. Structure of solids. II. Crystals and crystal growth. Kossel, D. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 15–42 (1947) *In German.*—Recent X-ray measurements of lattice constants particularly of graphite and graphitic acids are mentioned, the work of Hofmann leading to information on C–C atomic bonding. It is shown that the crystal growing nuclei in a metal can persist at temps. well above the melting point. Recent ideas of domain or mosaic structure in both metals and ionic solids are described, thus giving a partial explanation of the striations appearing on metal crystals during growth and the diffuse images obtained in X-ray diffraction studies of large single crystals. Reasons for the low mechanical strengths of many crystals, in contrast to the larger values calculated from atomic theory, are given, assuming a pattern of units larger than ions superimposed on the lattice structure; the low strength is then due to the weaker forces linking these units. The individual units are much stronger mechanically than the crystal treated as a whole. C. A. H.

548.0

5091. Sir C. V. Raman and crystal physics. Krishnan, R. S. *Proc. Indian Acad. Sci.*, **28**, 258–87 (*Nov.*, 1948).—A review, with a bibliography 328 papers by Raman and his pupils. A. J. C.

548.0 : 532.6

Relation between surface tension and crystalli habit. *See Abstr.* 4536

548.0 : 534.2

5092. Theoretical evaluation of the acoustic wa velocities in diamond. Ramanathan, K. G. *Pr Indian Acad. Sci.*, **28**, 370–6 (*Nov.*, 1948).

548.0 : 534.321

5093. Ultrasonic measurements on rochelle s crystals. Price, W. J. *Phys. Rev.*, **75**, 946– (*March* 15, 1949).—A pulse technique at 10 M has been used to study the anomalous elastic p perties of rochelle salt single crystals near the up Curie temp. The temp. dependence of foiled crys constant S_{44}^E and of the attenuation of waves wh contain a component of shear strain in the X crystall graphic plane is reported. The attenuation measu ments are formulated in terms of the interacti theory. The dependence of the velocity in 45° X crystals of rochelle salt on a d.c. field in the crystallographic direction shows a marked unipolari This change in velocity which is caused by the b field arises from the two following sources: one the usual saturation effect which produces a cha

n velocity that is independent of the polarity; the other is the morphic effect which results from the nduced monoclinic constants, and which produces a velocity change, the sign of which is dependent on he polarity. A.

548.0 : 535

5094. Coupling of translational and rotational external oscillations in crystals. KASTLER, A. *C.R. Acad. Sci., Paris*, **227**, 1024–6 (*Nov.* 15, 1948) *In French.*—In a crystal such as calcite, the external oscillations are those in which the CO_3 ion moves as a whole, and/or the Ca ions may move. For convenience, these oscillations may be regarded as translational or rotational in character: in the latter the CO_3 group librates. Considered by itself, a particular external oscillation appears to be inactive in the infrared or in the Raman effect, but experiment shows that more of these oscillations must be active than would be foreseen considering them one at a time. Coupling, however, will occur between external oscillations, provided they have the same symmetry. This coupling confers activity on those which otherwise would be devoid of it, by oscillations in the same mode, which are active. Detailed examples are given for calcite. A. C. W.

548.0 : 535.343.2

5095. Investigations on crystals in the infra-red spectrum. LECOMTE, J. *Proc. Indian Acad. Sci. A*, **28**, 339–48 (*Nov.*, 1948) *In French.*—A review, covering i.r. absorption, determination of indices of refraction by i.r. interference, and the detection of i.r. radiation by means of pyroelectric crystals. A. J. C. W.

548.0 : 535.43

5096. The influence of optical activity on light scattering in quartz. CHANDRASEKHARAN, V. *Proc. Indian Acad. Sci. A*, **28**, 409–16 (*Nov.*, 1948).—When a vertical plane-polarized beam of intense Hg 2 537 Å travels along the optic axis of a crystal of quartz the light vector is alternately parallel and perpendicular to the direction of observation transverse to the beam. The scattered light has bands of fluctuating intensity along the length of the slit for the Brillouin components and for the 2 symmetric Raman lines, but degenerate lines have uniform intensity. These results conform to theory. W. R. A.

548.0 : 535.51 : 538.613

5097. The Faraday effect and magneto-optic anomaly of some cubic crystals. RAMESHAN, S. *Proc. Indian Acad. Sci. A*, **28**, 360–9 (*Nov.*, 1948).—Using a Lippich double field polarimeter in conjunction with a spectrograph, the Faraday rotation for crystals and for concentrated aqueous solutions of NaCl, KCl, KBr, KI, NH_4Cl, NH_4Br, $NaClO_3$, $KAl(SO_4)_2$, $12H_2O$ and $NH_4Al(SO_4)_2$, $12H_2O$ have been measured for $\lambda\lambda$5893, 5780, 5461, 4358, 4046 and 3665. From measurements of the dispersion values the magneto-optic anomalies for the crystals and solutions have been calculated. The values for solutions of all except $NaClO_3$ and the alums are > for the crystals. W. R. A.

548.0 : 535.554

5098. The photoelastic properties of ionic crystals. BURSTEIN, E. AND SMITH, P. L. *Proc. Indian Acad. Sci. A*, **28**, 377–87 (*Nov.*, 1948).—Recent photoelastic data are used to obtain values of the change in refractive index μ with density for a series of cubic crystals. These experimental values are found to be < those calculated from either the Lorentz–Lorenz or the Drude equations. The difference between the experimental and calculated values results from a decrease in the molar polarizability with increase in density. In MgO the change in polarizability is relatively large and μ actually decreases with increase in density while the other crystals show an increase. The decrease in molar polarizability with density as measured by the strain-polarizability, λ_0, can be correlated with the amount of homopolar binding and ion overlap in the crystal. It is suggested that an increase in density increases the amount of homopolar binding and ion overlap. Further information about the dynamic changes in polarizability during vibration of the ions can be obtained from the change in μ with temp. at constant density and from Raman spectra. A.

548.0 : 537.228

Piezo-electric optical Kerr effect in crystals. *See Abstr.* 4769

548.0 : 539.214

5099. Mechanical properties of solids. II. Plasticity of crystalline substances. KOCHENDÖRFER, A. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 126–43 (1947) *In German.*—The theoretical developments of the subject are fully reviewed. Slipping between lattice planes, the plastic properties of single crystals and polycrystalline materials, the influence of "mosaic" structure on the plastic strength of crystals, and the nature of the elastic limit, are discussed. C. A. H.

548.0 : 539.32

5100. A modified method for the determination of elastic constants of crystals. SUNDARA RAO, R. V. G. *Proc. Indian Acad. Sci. A*, **28**, 475–9 (*Nov.*, 1948).—A Hartley shunt-feed oscillator is used to generate a variable frequency output for driving a piezoelectric tourmaline plate giving thickness oscillations of frequency equal to that of the oscillator. Although the amplitude is < that at resonance, it is sufficient to excite non-piezoelectric plates acoustically coupled to the driving plate. In this way the non-piezoelectric crystal plate is forced into ultrasonic vibration at its natural frequency. These ultrasonic vibrations are communicated to a transparent liquid touching the underside of the test specimen, and the ultrasonic waves in the liquid are detected by the Debye–Sears' phenomenon. The method has been used to determine the elastic constants of ammonium alum, barium nitrate and beryl. A. C. W.

548.0 : 539.32

5101. Elastic constants of ammonium chloride and ammonium bromide. SUNDARA RAO, R. V. G. AND BALAKRISHNAN, T. S. *Proc. Indian Acad. Sci. A*, **28**, 480–4 (*Nov.*, 1948).—The apparatus described in the previous Abstr. has been used to determine the elastic constants of NH_4Cl and NH_4Br. The relation between the elastic constants and the interionic distances for the alkali halides and the ammonium halides are discussed, and it is concluded that, for constant ionic charge, decrease of the

interionic distance increases the elastic constant. The experimental results satisfy Cauchy's relations for the crystals. A. C. W.

548.0 : 539.5

5102. Surface effects with single crystal wires of cadmium. ANDRADE, E. N. DA C. AND RANDALL, R. F. Y. Letter in *Nature, Lond.*, **162,** 890–1 (*Dec.* 4, 1948).—Thermal hardening of Cd single crystals was observed after heating in air for 20 hr at 200° C, or, if the crystal was slightly contaminated with $Cd(NO_3)_2$, after only 30 min heating [see Abstr. 3507 (1948)]. Other experiments are reported in which Cd single crystals under extension have been surrounded by various liquids, some resulting in either (*a*) an immediate increase in the rate of flow, or (*b*) hardening (with $Cd(NO_3)_2$, both are observed in sequence). (*a*) is attributed to the action of Cd ions, and (*b*) to the formation of a surface film. A. J. K.

548.1 : 513

5103. Crystallographic method of solving geometrical problems. BELOV, N. V. *Dokl. Akad. Nauk, SSSR,* **19** (*No.* 5) 897–8 (1948) *In Russian.*

548.1 : 513.84

5104. Axes of composite symmetry and matrix operators of improper rotation. FUMI, F. *R.C. Accad. Naz. Lincei,* **3,** 109–14 (*July–Aug.*, 1947) *In Italian.*—[See Abstr. 3565 (1949)]. Modifying a theorem of Seitz [Abstr. 3480 (1934)] the author proves that if a certain direction of a crystal is the axis of a proper rotation of an order $\geqslant 2$ there is always compatible with the existence of the axis considered a translation in this direction. The same is valid if the direction considered is the axis of an improper rotation of an order 1 or $\geqslant 3$. R. N.

548.24

5105. Etch and percussion figures, and twinning of quartz. PADUROW, N. N. *FIAT Rep.* [*H.M. Station. Off.*] (*No.* 1098) 71 *pp.* (1947) *In German and English.*—The report consists mainly of a literature survey. The types of twin (Japanese, right and left Dauphiné, Brazilian, Leydolt) are described, together with methods of determining orientation by etch and percussion figures. 41 references, 21 drawings, 27 photographs. A. J. C. W.

548.4

5106. Inclusions in aluminium crystals. TIEDEMA, T. J., MAY, W. AND BURGERS, W. G. *Acta Cryst.*, **2,** 151–4 (*June*, 1949) *In English.*—Al crystals, growing by recrystallization in fine-grained material, often do not consume some grains of the original material. They contain a number of inclusions, which do not vanish even after very long annealing. These reflect light simultaneously in the same direction. By means of (1) the etching method of Lacombe and Beaujard and (2) the X-ray method it is proved that these inclusions are deformed grains of the original material possessing spinel-twin relationship to the large surrounding crystal correct to within a few degrees. All 4 possible spinel-twin positions are represented. The above is not valid when the "inclusions" are larger than the average original grain size. In that case "inclusions" have an undeformed lattice and possess no special orientation. On the strength of these experiments it was expected that an Al crystal grown by recrystallization contains also inclusions with a orientation slightly different (by a few degrees) fro its own orientation. The existence of such inclusio has been proved by X-ray methods. By means of t etching-method it was possible to determine t orientation of inclusions with dimensions down 30 μ; for the X-ray method the dimensions had be of the order of 0·1 mm. To account for the o servations the assumption is made that a grain of t original material having approximately (within a fe degrees) a spinel-twin orientation towards a growi crystal of Al is left by the latter as an unconsume inclusion, whereas if the spinel-twin orientation perfect to within a fraction of a degree that gra may grow in exact twin position by "stimulation."

548

5107. Causes of the phenomenon of metastab states in crystallization. SIROTA, N. N. *J. Tec Phys., USSR,* **18,** 1136–48 (*Sept.*, 1948) *In Russian.*

548.51 : 532.7

5108. On the nucleation of centres of crystallizati in super-cooled liquids. IV. Activation by impuriti in salol. DANILOV, V. I., KOSACHKOVSKI, O. D. AN LABKOVSKI, YA. M. *J. Exp. Theor. Phys., USS* **18,** 886–92 (*Oct.*, 1948) *In Russian.*—The process activation by admixtures contained in Salol is i vestigated. The relationships found experimenta are considered on the working hypothesis of molecu contact set up between pairs of solids.

548.

5109. On the theory of the deposition of homopo crystals on structureless substrates. KAISCHEW, AND BLIZNAKOV, G. *C.R. Acad. Bulgar. Sci.*, 23–6 (*Oct.–Dec.*, 1948) *In German.*—A therm dynamic argument shows that a monatomic hom polar simple-cubic crystal is in equilibrium with 100 face in contact with the substrate, but that at hi temps. the speed of nucleus formation favours 111 face. A. J. C.

MOLECULAR AND X-RAY CRYSTALLOGRAPHY 548.7

54

5110. Graphite crystals and crystallites. I. Bind energies in small crystal layers. BRADBURN, COULSON, C. A. AND RUSHBROOKE, G. S. *Proc. R Soc. Edinb. A,* **62** (*Pt* 3) 336–49 (1948).—Using model of a crystallite layer of graphite in which i assumed that (i) all C–C distances are equal a (ii) that all C atoms are in the trigonal state postulated by Pauling, and application of the meth of molecular orbitals, calculations of resona energy, bond order, and bond length in a series graphitic layers of varying size, are given. Variati in resonance energy indicate that resonance favour square rather than oblong shape for the crystall For such layers in equilibrium in the presence of the most stable layer containing a given number C atoms is of the polyphenyl type. It is found t the polymerization of small groups of C atoms larger ones should be endothermic. C. A

548.7

5111. Graphite crystals and crystallites. II. Energies of mobile electrons in crystallites infinite in one direction. COULSON, C. A. AND RUSHBROOKE, G. S. *Proc. Roy. Soc. Edinb. A*, **62** (*Pt* 3) 350–9 (1948).—The methods of the preceding Abstr. are applied to a crystallite of ∞ length but finite width, i.e. a 1-dimensional analogue of a metal. For the resulting electron energy levels a continuous or a broken band structure is found. Thus some strips behave as conductors and others as insulators, but the distinction between the two may not be made on the basis of any simple chemical bond diagrams. C. A. H.

548.7

5112. Quasi-chemical theory of the ordering process of binary alloys. MIRTSKHULAVA, I. A. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 407–12 (*May*, 1949) *In Russian.*—A binary alloy at a given temperature is regarded as a mixture of "regular" atoms and distortions of various kinds. The thermodynamic potential of such a mixture is found and from the minimum condition of the latter the equilibrium figures of the distortions of various kinds are determined. These figures enable the stages of the far and near order of the crystal, and also the discontinuity of the specific heat on passing the Curie point to be determined. The latter reaches an appreciable value in the case of distortions of the higher types. B. F. K.

548.7

5113. Orientational-translational waves in molecular crystals. I. Dynamics of a linear lattice. ANSELM, A. I. AND PORFIR'EVA, N. N. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 438–46 (*May*, 1949) *In Russian.*—Oscillations of a linear crystal lattice are considered, each "particle" of which is possessed of translational and rotational degrees of freedom. It is shown that in such a lattice orientational and translational waves occur simultaneously; in the general case, both types of oscillations have a common spectrum of frequency *v.* wavelength. This spectrum has as many branches, as corresponds to the total number of degrees of freedom possessed by the elementary cell of the molecular crystal; in the linear lattice only one branch ($\lambda = 0$) originates at the frequency $\omega = 0$ (acoustic branch). Optically similar branches of orientational-translational oscillations, contrasting with the optical branch of a crystal consisting of particles of differing masses, may show positive as well as negative dispersion. At certain symmetry conditions in the relative position of the molecules ($g = h = 0$), the single spectrum of the oscillations is split up into separate, independent spectra of the orientational and translational oscillations. In the more general case of the crystal cell consisting of two molecules, the investigation of the limiting case $\lambda = \infty$ shows that one branch (acoustical) gives purely translational, the second branch purely orientational ($\omega \simeq \sqrt{J}$), and the 2 remaining branches, mixed oscillations. Work is in progress on extending the results obtained to the 3-dimensional lattice and applying it to the investigation of optical and thermal properties of molecular crystals. B. F. K.

548.7

5114. Structure of solids. III. Crystal chemistry of non-metallic substances. MEHMEL, M. *FIAT Rev. German Sci.* (1939–46) [*Off. Mil. Govt. Germany*] "*Physics of Solids, I*," 43–76 (1947) *In German.*—Details are given of the many measurements of lattice constants and structures of non-metallic crystals, both inorganic and organic, made and recorded in Germany during the war. C. A. H.

548.7 : 535.375.5

5115. The theory of the vibrations and the Raman spectrum of the diamond lattice. KRISHNAN, R. S. *Proc. Indian Acad. Sci. A*, **28**, 307–11 (*Nov.*, 1948).—The calculations of Smith [Abstr. 4023 (1948)] are not in accord with the experimental second-order Raman spectrum of diamond, and her paper ignores several of Krishnan's publications [Abstr. 601, 3489 (1947); 2794 (1948)]. A. J. C. W.

548.7 : 535.375.5

5116. The external oscillations of the crystal lattice of calcite. KASTLER, A. *Proc. Indian Acad. Sci. A*, **28**, 349–59 (*Nov.*, 1948) *In French.*—The planar CO_3 group is situated at the centre of an octahedron of Ca atoms, the threefold axis of the whole being $\parallel$ to the optic axis of the crystal. Because of the forces between O and Ca atoms, rotatory oscillation of the group is coupled with a translatory vibration $\parallel$ to the axis, and conversely. The external modes of oscillation are thus impure. Coupled modes always belong to the same symmetry class. Detailed application is made to the Raman and infrared absorption spectra. A. J. C. W.

548.7 : 535.375.5

Raman spectra of crystals. *See Abstr.* 4677–88

548.7 : 539.11

The vibrations of an infinite linear lattice consisting of two types of particles. *See Abstr.* 4905

548.73 : 535.4 : 537.531

Some new techniques in X-ray diffraction. *See Abstr.* 4809

548.73 : 537.531 : 535.3

5117. The dynamic X-ray reflections in carbon silicide. VENKATESWARAN, C. S. *Proc. Indian Acad. Sci. A*, **28**, 316–23 (*Nov.*, 1948).—The diffuse scattering round the $20\bar{2}1$ reflection of a flake of natural hexagonal carborundum is investigated over the temp. range $-180°$ to 600°C. The scattering is nearly independent of temp., and can be interpreted according to Raman's theory [Abstr. 1322 (1942)] in terms of a single lattice vibration of wave-number 830 per cm, observable also in the infrared absorption. It is not in accord with the "Born" theory of thermal scattering. A. J. C. W.

548.73 : 537.531 : 535.4

5118. A simplified treatment of the diffraction of X-rays from perturbed lattices. BOOTH, A. D. *Proc. Indian Acad. Sci. A*, **28**, 332–8 (*Nov.*, 1948).—Periodic distortions are treated by Jahn's method [Abstr. 1091 (1942)]; it is found that thermal scattering vanishes on the surfaces in reciprocal space for which the ordinary structure amplitude is zero [Abstr. 3243 (1946); 2629 (1948)]. Scattering due to random displacements without correlation between neighbouring cells is discussed qualitatively. A. J. C. W.

548.733

5119. LITMO X-ray goniometer (type Sauter I).

GOGOBERIOZE, D. B. AND YAVORSKY, I. V. *J. Tech. Phys., USSR*, **18** (*No.* 5) 707–12 (*May*, 1948) *In Russian.*

548.733

5120. An improved low angle X-ray diffraction camera. WRIGHT, B. A. AND COLE, P. A. *Rev. Sci. Instrum.*, **20**, 355–6 (*May*, 1949).—A description is given of a low angle X-ray diffraction camera which incorporates both high resolution and facility in adjustment and alignment of components. A diffraction pattern of the low angle pattern of collagen photographed with this instrument is compared with a similar pattern photographed with commercially available equipment. A.

548.733

5121. A high temperature X-ray diffraction camera. EDWARDS, J. W., SPEISER, R. AND JOHNSTON, H. L. *Rev. Sci. Instrum.*, **20**, 343–7 (*May*, 1949).—A high temp. powder diffraction camera has been designed to yield patterns at temps. $> 2\,500$°K. The sample, in form of a wire, compacted rod, or contained (wherever suitable) in a thin-walled quartz or ceramic tube, is heated indirectly by conduction and radiation in a thin-walled Mo, Ta or Pt furnace. The furnace is heated by high frequency (0·5 Mc/s) eddy currents induced by a small induction coil. The cylindrically shaped furnace and the sample are held coaxially in the induction coil and slowly revolved. The specimen temp. is maintained constant to $\pm 0{\cdot}2\%$ by an especially designed temp. regulator. A water-cooled Cu jacket with slots covered with metal foil to filter the diffracted X-radiation surrounds the furnace and is used to protect the X-ray film from heat and light. The temp. of the specimen is measured with a disappearing filament optical pyrometer at temps. $> 1\,100$°K and a Pt, Pt–Rh thermocouple at lower temps. The camera is either operated with a high vacuum or with an inert gas atmosphere. A.

548.733 : 537.531 : 621.386.1

5122. A 5 kW crystallographic X-ray tube with a rotating anode. TAYLOR, A. *J. Sci. Instrum. Phys. Ind.*, **26**, 225–9 (*July*, 1949).—A 4-windowed crystallographic X-ray tube with a rotating anode has been constructed. The bearings and seals on the rotating shaft are recessed within the vacuum envelope in the body of the anode, an arrangement which gives full accessibility to the window on the driving-belt side. The tube may be used alternatively with a stationary anode plated in segments with a number of metals which enables the characteristic wavelength to be rapidly changed without releasing the vacuum. The focus of the tube is adjustable while the tube is in operation. A.

548.734

5123. Theory of the Debye–Scherrer photograph of substances with pseudosymmetry. FAIVRE, R. *C.R. Acad. Sci., Paris*, **227**, 1254–6 (*Dec.* 8, 1948) *In French.*—If an n-fold axis of symmetry is reduced to an (n/m)-fold, pseudo-n-fold, axis each line on the photograph of a holohedral crystal (or a hemihedral crystal retaining its binary axis) separates into m equal components. If the binary axis of the hemihedral crystal is suppressed the intensities of the components are unequal. A. J. C. W.

548.734

5124. On two variations of Laue's method and the applications. GUINIER, A. AND TENNEVIN, J. *Acta Cryst.*, **2**, 133–8 (*June*, 1949) *In French.*—A geometrical property of white X-radiation diverging from a point source and reflected in a given family of crystal planes makes it possible to obtain photographs from which the scatter of the normals to these planes may be determined with an accuracy of 10 sec of arc, even in a relatively large crystal. In this way the degree of perfection of certain crystals has been assessed and a new type of imperfection has been discovered. An alternative experimental arrangement gives an image of the crystal from which its position and orientation and the position of a region of imperfection can be determined.

548.7

5125. Number-theory relations between lattice structures and quadratic forms in Debye–Scherrer (Hull) diagrams of cubic symmetry. EBERT, *Acta Cryst.*, **1**, 338 (*Dec.*, 1948) *In German.*—If the structure amplitudes are arranged in columns of according to the value of $h^2 + k^2 + l^2$ it is found that those of the same form ordinarily lie in horizontal rows. β-tungsten has one row in which the structure amplitudes are alternately of two forms. A. J. C. W.

548.735 : 539.18

5126. Secondary extinction and neutron crystallography. BACON, G. E. AND LOWDE, R. D. *Acta Cryst.*, **1**, 303–14 (*Dec.*, 1948) *In English.*—Extends the theory of secondary extinction to non-absorbing crystals and hence to neutron diffraction by crystals. With increasing thickness of crystal it is shown that the integrated reflection of a mosaic crystal falls away from proportionality to the square of the structure factor, and, for normal thicknesses, is dependent on the extent of the mosaic spread rather than on the structure factor. There is, however, a useful range of thickness in which the integrated reflection is proportional to the first power of the structure factor. Criteria for "thin," "thick," "non-absorbing" and "absorbing" crystals are given and the importance for neutron crystallography is discussed. J.

548.735 : 539.37

Crystal orientation of thallium halides. *See Abstr.* 5029

548.735

5127. Contribution to the knowledge of the A_5B phases. HEUMANN, T. *Nachr. Wiss. Göttingen* (*No.* 1) 21–6 (1948) *In German.*—New members of the group are Co_5Ce (hexagonal, $a = 4{\cdot}94$ Å, $c = 4{\cdot}047$ Å), Co_5Th ($a = 4{\cdot}940$, $c = 4{\cdot}031$ Å), Ni_5Th ($a = 4{\cdot}911$, $c = 3{\cdot}982$ Å) and $(Cu_{4\cdot8}Ce_{0\cdot2})Ce$ ($a = 5{\cdot}131$, $c = 4{\cdot}124$ Å). A necessary but insufficient condition for an A_5B phase is a radius ratio $r_B/r_A \simeq 1{\cdot}5$. So far only Co, Ni, Cu and Zn have been observed as A atoms; the likely Fe alloys have been investigated. A. J. C. W.

548.735

5128. The measurement of small differences between lattice spacings of two solid solutions. STEWARD, E. G. *Acta Cryst.*, **1**, 339 (*Dec.*, 1948) *In English.*

548.735.4

129. The determination of the unit-cell dimensions of non-cubic substances. BACON, G. E. *Acta Cryst.*, 337 (1948) *In English.*—The substance is mixed with a cubic substance, and lines due to both are measured. From the measured and extrapolated values of a for the cubic substance the correction factor required to eliminate absorption and other errors is obtained; this factor is then applied to the spacings observed for the non-cubic substance. The spacings of BeO (hexagonal) at 21 ± 0·5°C are found to be $a = 2·6978$, $c = 4·3779$ Å (CuKα_1 assumed to be 1·54050 Å). A. J. C. W.

548.735.44

130. A simple device for calculating X-ray structure factors. VAND, V. Letter in *J. Sci. Instrum. Phys. Ind.*, **25**, 352 (*Oct.*, 1948).—To sum $F = \Sigma f_i \cos 2\pi u_i$, the values of u_i are laid off around concentric circles of radii f_i. A sheet of celluloid, marked with an arrow and constrained to move along a horizontal straight-edge is laid over the circles, and the arrow is set to the vertical line through the centre of the circles. An ink dot is made on the celluloid at u_1, the celluloid moved so that the dot comes to the line, a second dot is made at u_2, the celluloid is moved so that the second dot comes to the line, and so on. The final displacement of the arrow from the line is F on the same scale as the radii of the circles. A. J. C. W.

548.735.44

131. Fourier aspects of implication theory. GUERGER, M. J. *Proc. Indian Acad. Sci. A*, **28**, 324–31 (*Nov.*, 1948).—The implication diagram [Abstr. 696 (1947)] is developed from Fourier synthesis instead of from group theory, and the resolution of ambiguities is discussed. Compare Abstr. 3531 (1948), 246 (1949). A. J. C. W.

548.735.44

132. The derivation of atomic co-ordinates from planar and linear Fourier syntheses. PARRY, G. S. AND PITT, G. J. *Acta Cryst.*, **2**, 145–7 (*June*, 1949) *In English.*—The choice of planes and lines for computing Fourier syntheses is discussed with the object of minimizing the number of computations by which all the atoms in a planar molecule may be located. Formulae are derived for deducing the atomic co-ordinates from the positions of max. electron density in such general sections and lines. A.

548.735.44

133. The accuracy of atomic co-ordinates derived by least-squares or Fourier methods. CRUICKSHANK, D. W. J. *Acta Cryst.*, **2**, 154–7 (*June*, 1949) *In English.*—Recent work by Cruickshank on the accuracy of atomic co-ordinates obtained in Fourier syntheses is here related to that of Cochran on the connections between the least-squares and Fourier methods. Except when the atomic peaks are not resolved, it is shown that the same co-ordinates and estimated errors are obtained by the method of least squares and by appropriately weighted Fourier series (corrected for finite summation). An expression is obtained for the relative accuracies of the weighted and unweighted Fourier methods. A.

548.735.44 : 518.5

134. The use of punched-card machines for Fourier and Patterson synthesis of crystals. NOWACKI, W. *Chimia*, **2**, 274–6 (*Dec.* 15, 1948) *In German.*—Surveys the use which has so far been made of Hollerith-type machines for Fourier and Patterson syntheses, and indicates the way in which these machines may be used for 2- and 3-dimensional summations. J. T.

548.735.7 : 537.531 : 535.41

5135. Displacement of the interference maxima with variation of the size and shape of very small crystals. SHISHAKOV, N. A. *J. Exp. Theor. Phys., USSR*, **19** (*No.* 5) 431–7 (*May*, 1949) *In Russian.*—Calculations by Debye's equation show that anomalies exist in the diffraction of crystals of a limiting small size. The maxima of 3-dimensional crystals are found at the corresponding Bragg angles, but their relative intensities show anomalies. 2- and 1-dimensional crystals show, in addition, shifts of the maximum position from the Bragg positions. This phenomenon is explained and some examples of the application of the shift rule are given. B. F. K.

548.736

5136. The structures of some metal compounds of uranium. RUNDLE, R. E. AND WILSON, A. S. *Acta Cryst.*, **2**, 148–50 (*June*, 1949) *In English.*—The compounds UAl_2, UAl_3, UAl_5, UHg_2, UHg_3, UHg_4 and USn_3 all have standard type structures, except UHg_4 and UAl_5, which are quite complex. UHg_4 appears to be a distortion of a body-centred cubic arrangement. The structure of UAl_5 remains unknown. A.

548.736.3

5137. Determination by X-rays of the crystal structures of the chloride and bromide of boron in the solid state. ROLLIER, M. A. AND RIVA, A. *Gazz. Chim. Ital.*, **77**, 361–6 (1947) *In Italian.*—Powder data are tabulated for BCl_3 and BBr_3 condensed on a capillary tube containing liquid air. BCl_3 has a_0 6·140, c_0 6·603 Å c/a 1·075; BBr_3 has a_0 6·406, c_0 6·864 (all ± 0·010) Å, c/a 1·071; both have 2 mols. per unit cell and space-group C_6^6. Atomic parameters are deduced, and observed and calc. intensities are compared. The c/a ratios are similar to those of CHI_3 (1·104) and PI_3 (1·043). B. A.

548.736.3

5138. The lattice parameters of γ-Al_2O_3. KÖNIG, H. *Naturwiss.*, **35** (*No.* 3) 92–3 (1948) *In German.*—Values ranging from 7·73 ± 0·1 to 8·06 ± 0·02 Å are quoted in the literature. Electron-diffraction comparisons with LiF ($a = 4·020$ Å) show that when the oxide is in contact with metallic Al $a = 7·89$ Å, but in the absence of Al, O may be absorbed, increasing a to 8·06 ± 0·01 Å. A. J. C. W.

548.736.3

5139. The crystal structure of $ThCl_4$ and UCl_4. MOONEY, R. C. L. *Acta Cryst.*, **2** (*Pt* 3) 189–91 (1949) *In English.*

548.736.3

5140. Crystal structure of InBi. MAKAROV, E. S. *Dokl. Akad. Nauk, SSSR*, **19** (*No.* 5) 899 (1948) *In Russian.*

548.736.3

5141. Study of the formation of order in the Au–Cu_3 gold-copper solid solutions. GUINIER, A.

AND GRIFFOUL, R. *Rev. Métall.*, **45**, 387–96 (*Oct.*, 1948) *In French.*—An X-ray study of an Au–Cu_3 alloy in different states of order leads to the following conclusions. After quenching there already exists a short range order. Annealing at 200–250°c causes an intermediary state to be set up. This intermediary state possesses a certain stability and marks the transition from disorder to order. It is built of small perfectly ordered domains of uniform size and shape, but which are out of step with one another. Fault planes are shown to be parallel to the 100 planes; the mistakes occur such that the Au atoms avoid one another—as envisaged by Wilson. Faults occur with a periodicity ~ 40 Å. A similar structure is suggested for a perfectly ordered alloy since on this basis the strong 110 reflection is more easily appreciated. H. P. M.

548.73

5142. The crystal structure of K_2CuCl_3 and i morphous substances. BRINK, C. AND MACGILLAVI C. H. *Acta Cryst.*, **2**, 158–63 (*June*, 1949) *In Engli*

548.73

5143. The crystal structure of sodium sesq carbonate. BROWN, C. J., PEISER, H. S. A TURNER-JONES, A. *Acta Cryst.*, **2**, 167–74 (*Ju* 1949) *In English.*

548.73

5144. The crystal structure of atacamite and crystal chemistry of cupric compounds. WELLS, A. *Acta Cryst.*, **2**, 175–80 (*June*, 1949) *In English.*

548.7

5145. The crystal structure of hexamethylened mine dihydrochloride. BINNIE, W. P. AND ROBERTS J. M. *Acta Cryst.*, **2**, 180–8 (*June*, 1949) *In Engli*

GEOPHYSICS 55

550.3

5146. The theory of land-bridges and the viscosity of the earth. PREY, A. *S.B. Öst. Akad. Wiss., Abt. IIa*, **156** (*Nos* 9–10) 629 (1948) *In German.*—To account for the former junction of continents, now separated, are two hypotheses—that of continental drift and that of sunken land bridges. The former depends on horizontal movement, the force producing which is very small: the latter on vertical movement, which is considerable. The paper is a mathematical investigation of the land-bridge theory, depending on the assumption that the earth's sial layer was originally disrupted by the formation of the moon. W. A. R.

550.34 : 534.23

Rayleigh waves in an infinite, firmo-viscous medium. *See Abstr.* 4577

550.341 : 534.647

Triggered telerecording seismic equipment. *See Abstr.* 4586

550.38

5147. The movements of the pole of terrestrial rotation during the years 1938–48. CARNERA, L. *Bull. Géod.* (*No.* 10) 269–84 (1948) *In Italian.*—The movements of the pole, calculated from the station latitudes, are tabulated and graphed. W. A. R.

550.38

5148. On the essential difference between magnetic storms of sudden and gradual appearance as far as it concerns the 27-day cycle. THELLIER, E. AND THELLIER, O. *C.R. Acad. Sci., Paris*, **227**, 1044–6 (*Nov.* 15, 1948) *In French.*—A statistical study of 688 storms occurring since 1884 showed that 210 had a definitely sudden onset, whilst 328 appeared gradually. For each of these 2 groups the magnetic characteristic "*C*" has been plotted over a period of 180 days centred on the time of onset of the storm. Whilst the storms commencing suddenly show no recurrence tendency, those of gradual appearance show a definite 27-day recurrence. This helps to explain the classical observations of Greaves and Newton [Abstr. 3296 (1949)]. A. C. C.

550

5149. Pre-history of the earth's magnetic fie JOHNSON, E. A., MURPHY, T. AND TORRESON, O. *Terr. Magn. Atmos. Elect.*, **53**, 349–72 (*Dec.*, 1948) The possibility of discovering the early history of earth's magnetic field from studies of the pres magnetic polarization of certain clay deposits is d cussed. Laboratory experiments are described wh indicate that such deposits would have acquired magnetic polarity determined by the earth's field the time they were laid down, and that they ha retained this polarity almost unimpaired throughc geologic time. An elaborate investigation of layer glacial clays from New England indicates that earth's field has not changed substantially in directi or intensity during the last 15 000 years. The stu of one anomalous deposit in particular affo striking confirmation of the geologic stability of polarization of these clays. Some prelimina measurements of magnetic polarity of 5 core samp of sediments from the Pacific are also describe these sediments were dated by measurements radioactive equilibrium and probably cover period of the last million years. It is tentatively cc cluded that the earth's magnetic field has remain substantially constant in direction and intens during that time. A. T.

550

5150. The use of potential fields in geophysic prospecting. GASSMANN, F. *Mitt. Inst. Geophy E.T.H. Zurich* (*No.* 9) 335–52 (*June*, 1948) *In Germa*

550.

5151. Monazite from Bodmin Moors, Cornwa a study in geochronology I. Monazite as a geologi timekeeper. II. Analysis of Bodmin Moor monaz for lead, thorium and uranium. HOLMES, A. A SMALES, A. A. *Proc. Roy. Soc. Edin. B*, **63**, *Pt* 115–29 (1948).—Monazite is unreliable as an a indicator unless the proportions of Pb isotopes a determined. W. A.

551.482 : 532.5

5152. The behaviour of waves on tidal strea

ARBER, N. F. *Proc. Roy. Soc. A*, **198**, 81–93 *uly* 22, 1949).—Discusses the manner in which ves change their characteristics when they pass rough regions where the water has a streaming otion. The treatment applies to tidal streams, the locity of which depends both on time and position. me experimental evidence is provided in support the theory. A.

ATMOSPHERE . METEOROLOGY 551.5

551.509

53. A note on polar air-mass modification. ROST, R. *Proc. Roy. Soc. A*, **198**, 27–38 (*July* 22, 949).

551.509

54. A numerical method for predicting the perrbations of the middle latitude westerlies. CHARNEY, G. AND ELIASSEN, A. *Tellus*, **1**, 38–54 (*May*, 949) *In English.*—It is shown that the large-scale asi-stationary disturbances of the middle-latitude esterlies are produced by the forced ascent of e westerly current over the continental land asses. Friction is found to have an important odifying effect on the motion. Using these results numerical method is devised for predicting the ight profile of the 500 mb pressure surface at a ed latitude. The method involves the use of the otion of an "equivalent-barotropic atmosphere" id of the geostrophic approximation. 6 actual foreists are made for a period of one day and the results mpared with observation. The accuracy obtained thought to justify incorporation of the method into ay-to-day forecast procedures. A.

551.510.4

155. Nitrous oxide in the earth's atmosphere. HAW, J. H., SUTHERLAND, G. B. B. M. AND ORMELL, T. W. Letter in *Phys. Rev.*, **74**, 978–9 *Oct.* 15, 1948).—Atmospheric N_2O has been identified solar spectra recorded from $2{\cdot}5\,\mu$ to $5{\cdot}0\,\mu$ at ambridge, England, confirming the work of Adel 939–41) at Flagstaff, U.S.A. Results indicate a orld-wide distribution; and determination of rtical distribution of the gas may throw important ght on present views of radiative equilibrium of the tmosphere. D. R. B.

551.510.535

156. Chalmers solar eclipse ionospheric expedition, 945. RYDBECK, O. E. H. *Trans. Chalmers Univ. ech. Gothenburg* (*No.* 53) 5–42 (1946) *In English.*—etails of vertical incidence ionospheric measurements t site in northern Sweden (lat. 63.68°N, 20.06°E) uring the solar eclipse of July 9, 1945. Results for and F_1 layers confirm the importance of solar u.v., articularly coronal radiation, in the formation of ese layers. A definite but complex eclipse effect as noted for region F_2. There was no evidence of a rpuscular eclipse. Estimates of recombination efficients, based on the eclipse measurements, are 1×10^{-8} (E), $0{\cdot}6\times10^{-8}$ (F_1) and 3×10^{-9} (F_2). It suggested that F_2 eclipse effects are different in igh and low latitudes and subject to geomagnetic control. The general problem of eclipse variations in electron density for ionospheric layers is examined theoretically and it is concluded that for the F_2 layer the effect of horizontal diffusion on such variations is unimportant. W. J. G. B.

551.510.535

5157. Note on night-time phenomena in the F_2 region at Brisbane. GIPPS, G. DE V., GIPPS, D. I. AND VENTON, H. R. *J. Coun. Sci. Industr. Res., Aust.*, **21**, 216–21 (*Aug.*, 1948).—Abnormal phenomena (diffuse echoes, multiple splitting, etc.) are described and possible ionosphere configurations to produce the phenomena are discussed. W. J. G. B.

551.510.535

5158. Variation in the height of the F layer causing changes in the frequency of radio waves during the course of propagation. RAWER, K. *C.R. Acad. Sci., Paris*, **227**, 1149–51 (*Nov.* 29, 1948) *In French.*—Observations of frequency changes of 20 parts in 10^8 during transatlantic transmission of a frequency of 5 Mc/s is attributed to vertical motion in the F layer. Using normal incidence ionospheric data and assuming a 5-hop mode of transmission, it is shown that calculated values of the expected Doppler frequency shift are in good agreement with those observed. W. J. G. B.

551.510.535

5159. Layer formation at the level of region E in the ionosphere. BURKARD, O. AND WINTER, L. *Öst. Z. Telegr. Teleph. Funk Fernsehtech.* [*ÖTF*] **2**, 147–51 (*Sept.–Oct.*, 1948) *In German.*—From a study of sporadic E data from 3 stations (Köchel, lat. 48°N, Oslo, lat. 60°N and Tromsö, lat. 70°N) it is concluded that at least 3 sources of ionization at the level of region E can be recognized. (*a*) The normal E ionization due to photoionization by solar u.v. radiation, probably in the wavelength range 661–774 Å. (*b*) Ionization resulting from a recombination process between excited atoms. (*c*) Ionization produced by the corpusular streams which cause auroral and magnetic storms. W. J. G. B.

551.510.535 : 523.75

5160. Ionospheric effects of solar flares 1948. RYDBECK, O. E. H. AND STRANZ, D. *Tellus*, **1**, 6–21 (*Feb.*, 1949) *In English.*—The results of the first half year's observations at Gothenburg are presented and analysed in this preliminary communication. The statistical distribution of radiation sources of stronger and weaker fade-outs across the solar disc is shown. The magnitude and probability of the absorption of the ultraviolet fade-out radiation in the solar corpuscular beam is discussed. A.

551.513

5161. On the scale of atmospheric motions. CHARNEY, J. G. *Geofys. Publ.*, **17** (*No.* 2) 3–17 (1948) *In English.*—In a previous paper [*J. Met.*, **4**, 135–62 (1947)] the author pointed out that the introduction of certain approximations in the atmospheric wave motion equations had the effect of "filtering out" the meteorologically insignificant wave solutions. This method is extended in the present paper to apply to the most general large-scale motions. In order to effect this, a theory of meteorological approximations is first dealt with. It has been

found from experience that weather-producing motions of the free atmosphere can be characterized as quasi-horizontal, quasi-hydrostatic, quasi-adiabatic and quasi-geostrophic. Though the first 3 can be introduced easily, difficulty has been experienced in using the geostrophic approximation in dynamic analysis. This approximation is now, however, introduced into the equations of motion. Application of the simplified equations is then considered. The use of the tendency equation as a prognostic tool is investigated and it is shown that in a modified form it may be used to determine the velocity of propagation of long waves of both infinitesimal and finite amplitude. The expression obtained for the velocity of baroclinic waves of infinite lateral extent is in the author's opinion well adapted for numerical integration from the observed distributions of amplitude and velocity. Many references. A. E. M. G.

551.513

5162. On the dispersion of planetary waves in a barotropic atmosphere. ROSSBY, C.-G. *Tellus*, **1**, 54–8 (*Feb.*, 1949) *In English.*—An attempt is made to investigate the rate of dispersion of solitary, quasi-horizontal atmospheric disturbances with the aid of a simple barotropic model of the atmosphere. In low latitudes the dispersion is found to be extremely rapid, in good agreement with the observed absence of all but the smallest solitary disturbances. In high latitudes the dispersion is slow, permitting the establishment of persistent solitary circulation patterns. The theory appears to throw some light on the geographic distribution of the interdiurnal variability in the height of the 500 mb surface and on the relatively frequent occurrence of planetary waves with a wavelength of 120 longitude degrees. A.

551.513

5163. Eddy diffusion of water vapour and heat near the ground. PASQUILL, F. *Proc. Roy. Soc. A*, **198**, 116–40 (*July* 22, 1949).—An experimental study has been made of the factors involved in the turbulent transport of water vapour and heat in the lowest layer of the atmosphere over well exposed level grassland. The bearing of the results on the problem of indirectly evaluating natural land evaporation is briefly discussed and attention drawn to the implied superiority of the present "hydrodynamical" approach over the classical "heat-balance" method. A.

551.556

5164. Deformations of the earth's surface under external influences. BONCHKOVSKI, V. F. *Dokl. Akad. Nauk, SSSR*, **60** (*No.* 6) 981–4 (1948) *In Russian.*—Darwin's theory of the earth's surface deformation under external forces is applied to the effects of cyclones and anti-cyclones.

551.574.1

5165. Ice in the atmosphere. DOBSON, G. M. B. *Quart. J. Roy. Met. Soc.*, **75**, 117–30 (*April*, 1944).—In Presidential Address to the Royal Meteorological Society, Jan., 1949.

551.578.1

5166. The problem of artificial control of rainfall on the globe. I. General effects of ice-nuclei in clouds. BERGERON, T. *Tellus*, **1**, 32–43 (*Feb.*, 1949) *In English.*—Different kinds and degrees of colloidal and thermodynamical instability of diverse systems of cloud-particles, partly leading to release of p cipitation, are discussed, aiming at estimating possible effect of "seeding" clouds artificially w ice-nuclei. A low ratio v of supercooled clo droplets v. ice-crystals ($v \leqslant 1$) would ensure v rapid glaciation of the cloud, but no precipitat release and no substantial improvement of visibi within it: (overseeding). High values of v ($>$ would lead to the formation of big, though v sparse precipitation elements, but not noticea improve visibility within the cloud: (underseedi Favourable values of v seem to lie around Cases of successful artificial seeding may be explai by natural seeding indirectly caused by the artifi one: (double release). Lastly, an inventory of actual tropospherical clouds and cloud systems i cates that the main possibility for causing consi able artificial rainfall might be found within cer kinds of orographic cloud systems.

551.5

5167. Variations in the index of refraction of atmosphere. GERSON, N. C. *Geofis. Pura A* **13**, 88–101 (*Sept.–Oct.*, 1948).—Discusses atmospheric refractive index (*a*) throughout the at the earth's surface and (*b*) for each season different air masses. The annual variation in refractive index at the earth's surface is examined noting the contributions of the optical and wa vapour terms. The forms vary sinusoidally wit period of a year, having a max. in winter and a during the summer. The amplitude of the depends upon lat., appearing greater in polar tha tropical regions. The magnitude of the wa vapour term is more strongly dependent upon season and lat. Excepting areas where the dew p changes little from month to month, the water-va term attains a single yearly max. at about mid- Graphs of the variation of refractive index altitude are included for the major air mas Highest values of the index up to a height of 6 are found in tropical, maritime and monsoon masses; lowest values in arctic masses. The rat decrease of refractive index with height is usually different for diverse air masses. From the surfac an altitude of 6 km, the most constant rate of decr with altitude, considering all air mass types, found in the superior air mass. H.

551.593.55 : 535

5168. Influence of the multiple diffraction of on the brightness of the twilight sky. ROSENB G. V., KHVOSTIKOV, J. A. AND YUDALEVICH, F *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 7) 1277–9 (1 *In Russian.*—A criticism of Hulbert's treat [Abstr. 3178 (1938), 2717 (1947)] both on theore and observational grounds.

551.593.55 : 535

5169. The influence of the second order diffra on the zenithal twilight brightness. STAUDE, N *Dokl. Akad. Nauk, SSSR*, **59** (*No.* 7) 1281–2 (1 *In Russian.*—See preceding Abstr. Hulburt's re are partly confirmed (for a low sun), and p found far too small (for the sun still relatively h

551.5

5170. Spectrophotometric researches on the ligh the night sky in the visible region. II. DUFAY, J.

CHENG, M.-L. *Publ. Obs. Haute-Provence* (*No.*); *Ann. Geophys.*, **3** (*No.* 3) 153–83 (1947) *In* ench.—Observations of the 3 principal emis- on lines at 5 577, 5 892 and 6 300 Å, from 1940 1944, support the following conclusions. Of the radiations, that at 5 577 Å alone exhibits a slow tensity variation, possibly synchronized with the nspot cycle. This fact is emphasized by the strong rrelation of auroral-line intensity and magnetic tivity which shows also a marked 27-day recurrence ndency. The radiations at 5 892 and 6 300 Å do t exhibit significant correlations with terrestrial agnetic and solar activity. All 3 emission inten- ies undergo an annual variation, the green radiation ving max. in February and October, and both llow and red radiations show a pronounced min. ound the summer solstice. D. R. B.

551.593.9 : 535.33

71. The spectrum of the night sky in the region of orter wavelengths to 5 000 Å. BARBIER, D. *Publ. bs. Haute-Provence* (*No.* 2); *Ann. Geophys.*, (*No.* 3) 224–32 (1945) *In French.*—Wavelength easures of the principal radiations obtained om spectrograms covering the interval 3 000– 00 Å show good agreement with those of Elvey, ings and Linke. The influence of Fraunhofer sorption on the energy distribution in the spectrum pears negligible. D. R. B.

551.594.5

72. Excitation mechanism of red aurorae of pe *B*. BERNARD, R. AND PEYRON, M. *C.R. Acad. i., Paris*, **227**, 1151–2 (*Nov.* 29, 1948) *In French.*—A spectrum closely analagous to that of red aurorae (type *B*) is observed when an electronic discharge is started in air at pressures from 0·1 to 0·3 mm Hg. The red discharge becomes stable a few sec after initiation, turning predominantly blue. From this it is inferred that the red zones of type *B* aurorae indicate instability in the discharge channel. The absence of red fringes in stationary displays, and the red border along advancing "folds" of mobile "drapery" in this type of aurora, lend confirmation to the inference as stated. D. R. B.

551.594.5

5173. Frequency of 12,330 measured heights of aurora from southern Norway in the years 1911–1944. STÖRMER, C. *Terr. Magn. Atmos. Elect.*, **51**, 501–4 (*Dec.*, 1946).—The height distribution, with its maximum at 100–110 km, is clearly depicted in a chart embracing all the observations. F. T. F.

551.594.5

5174. Active nitrogen. MITRA, S. K. *Phys. Rev.*, **74**, 1637–9 (*Dec.* 1, 1948).

551.594.6

5175. On the measurement and nature of atmospherics produced by electric discharges in snow squalls and from other sources. NORINDER, H. *Tellus*, **1**, 1–13 (*May*, 1949) *In English.*—Deals with a special type of atmospherics produced within snow squalls and discusses the genesis of such atmospherics. There is also a discussion of the theoretical principles and methods of measuring atmospherics by means of open-air aerial circuits and suitable c.r.t.'s. The article contains examples of typical meteorological situations with atmospherics of the type discussed. A.

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578 : 536.6

76. A simple calorimeter for the simultaneous termination of heat loss and heat production in imals. PROUTY, L. R., BARRETT, M. J. AND HARDY, D. *Rev. Sci. Instrum.*, **20**, 357–63 (*May*, 1949).—scribes a new type of gradient calorimeter which rmits the rapid simultaneous measurement of piratory metabolism and heat loss. It uses the np. difference between the inner and outer aspect a fixed transitional layer of air rather than adiabatic nciples. Application of gradient principles to orimetry so simplifies heat loss determinations that y become the easiest and most accurate part of the ocedure. A.

591.11 : 537.226

The temperature dependence of the dielectric nstant of blood at low frequencies. *See Abstr.* 4759

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612.84

77. A comparison of electrical and psycho- ysical determinations of the spectral sensitivity of human eye. RIGGS, L. A., BERRY, R. N. AND WAYNER, M. *J. Opt. Soc. Amer.*, **39**, 427–36 (*June*, 1949).—Electrical responses of the human retina have been measured by the use of an electrode mounted on a contact lens. The form and magnitude of such responses have been determined for stimulation by filtered lights having various dominant wavelengths. Two sets of spectral sensitivity data, one for the dark-adapted eye and the other for the light-adapted, have been obtained by computing the intensity of stimulation necessary at each wavelength to arouse an electrical response of a given small magnitude. Comparable data have been obtained in psycho-physical experiments in which the same filter combinations and closely similar methods of computation have been employed. The electrical data, for both the light-adapted and the dark-adapted eye, agree much more closely with the psycho-physically determined scotopic sensitivity curve than with the photopic. It appears, however, that lights of the shorter wavelengths are somewhat more effective in arousing electrical responses than the scotopic sensitivity curve would predict. A.

612.84 : 535.317.4

5178. The spherical aberration of the eye. KOOMEN, M., TOUSEY, R. AND SCOLNIK, R. *J. Opt. Soc. Amer.*, **39**, 370–6 (*May*, 1949).—The spherical aberration of

the eye was measured by placing a series of centred annular apertures over the eye pupil, and determining the optimum spectacle correction for each aperture. A "double star" was used as a test object. Accommodation was controlled by reflecting a second test object into the field of view. The 3 eyes examined had positive (undercorrected) spherical aberration when unaccommodated; in one case 2 diopters at the pupil margin. The aberration was reduced with increasing accommodation and in one case became negative at high accommodation. Homatropine reduced the spherical aberration of 2 of the 3 eyes examined. A historical review of previous work is given. A.

612.85

5179. Measurements of auditory fatigue with the automatic audiometer. SACERDOTE, G. G. *Alta Frequenza*, **17**, 257–64 (*Dec.*, 1948) *In Italian.*—A modified form of the recording audiometer described by von Békésy [Abstr. 273 (1948)] has been used to measure the effect of a loud sound on the sensitivity of the ear. Records are reproduced which show that after the application of the loud sound a loss in sensitivity occurs but the sensitivity gradually improves again. The sensitivity loss depends on the intensity of the loud sound and is greatest at the frequency of the loud sound. T. S. E. T.

614.8 : 539.172.4

5180. The metabolic properties of the fission products and actinide elements. HAMILTON, J. G. *Rev. Mod. Phys.*, **20**, 718–28 (*Oct.*, 1948).—Expts. with the 22 main fission products on rats, in which ingestion was caused by oral intake, injection and lung inhalation, are described. Carrier-free elements were used, and after a few weeks the skeleton and principal organs were analysed for radioactive content. Results showing the main sites of deposit and the routes by which various elements are retai are given, and auto-radiographs from 0·005 sections of bone showing detailed distribution included. F. T

615.

5181. Researches on the biological properties micro-waves with a view to their therapeutic ap cation. DE SÉGUIN, L., CASTELAIN, G. AND PELLET M. *Rev. Sci., Paris*, **86**, 335–44 (*April* 1, 1948) *French.*—Waves of 21 cm λ were used to st specific effects on tissue cultures and the distribu of heating within dead and living tissues. cultures were taken from chick embryo and spl and the rate of growth was compared for no and h.f. heating to the same temp. by tracing ro the section before and after irradiation. Temp. was measured by thermo-junctions, extrapola back to time of end of exposure. With small te elevations the h.f. treated specimens showed siderably greater growth rate than the controls, a specific effect, attributable to the small-scale inho geneity of heating in different constituents of tissue, is demonstrated. Energy absorption measured, using an H_{01} wave, on a number of b tissues and showed a depth of half-energy penetra of the order of 1·4 cm; fatty tissue, however, about 4 times as transparent as others at this w length. F.

615.849 : 535.43 : 537

Approximate solution of a problem of scatterin soft X-rays [λ between 0·25 and 0·56 Å]. *See A* 4810

615.849 : 537

A mobile Geiger–Müller tube counting system some of its medical applications. *See Abstr.* 4840

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771.351 : 535.43

5182. Nephelometer for photographic lenses. LOSCO, D. *Atti Fond. "Giorgio Ronchi,"* **3**, 147–50 (*Oct.–Dec.*, 1948) *In Italian.*—An apparatus to study the state of cleanness of photographic lenses is described. The lens to be tested is strongly illuminated from an off-axis direction. Stray light causes a small hole at the back focus of the lens to become luminous. Its brilliance is determined by means of visual photometry. Results show that some lenses, previously judged as dirty by their external appearance, may diffuse very little light, and conversely. Fatty or greasy stains on the lens surfaces may give rise to considerable diffusion. A.

778.3 : 53

5183. Proposed method for measuring scatterin particle tracks. GOUDSMIT, S. A. AND SCOTT, W Letter in *Phys. Rev.*, **74**, 1537–8 (*Nov.* 15, 1948). measurements of scattering of atomic particle t the length of the track usually is divided in number of equal segments. The small angles bet the chords of consecutive segments have t measured for the evaluation of scattering. A for for a simplified method is derived for which o knowledge of the length of the curved track an distance between the ends of the track is requ The curved track can be measured by means map measurer. The angle method is more acc if the mean scattering becomes unusually large. R.